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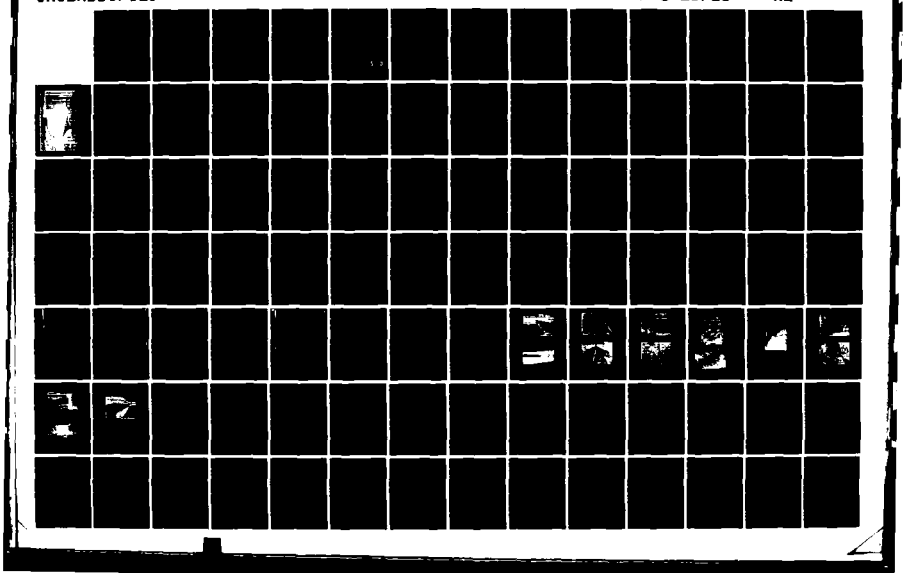

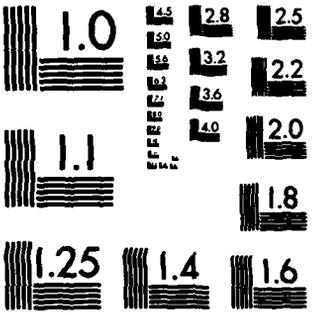

FARMINGTON RIVER BASIN

HARWINTON, CONNECTICUT

(1)

BRISTOL RESERVOIR NO.5 DAM
CT 00366

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JULY 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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4. TITLE (and Subtitle) Bristol Reservoir No.5 Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Farmington River Basin
Harwinton, Connecticut

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Bristol Reservoir No.5, a storage reservoir for public water supply, is impounded by a main dam located on the south side of the reservoir and a dike located on the west side. The main dam consists of an earth embankment with a top width of 8 feet, a maximum height of 60 feet, and a length of 640 feet. The dike consists of an earth embankment with a top width of 7 feet, a maximum height of 10 feet, and an overall length of 740 feet. Based on the visual inspection, the dam and dike are judged to be in good condition. The dam is classified as "Intermediate" in size, with a "High" hazard potential. A test flood equal to the PMF was selected.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

OCT 29 1980

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the Bristol Reservoir No. 5 Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, Bristol Water Dept, Bristol, Connecticut.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

BRISTOL RESERVOIR NO. 5 DAM
CT 00366

FARMINGTON RIVER BASIN
HARWINTON, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

IDENTIFICATION NO: CT 00366

NAME OF DAM: Bristol Reservoir No. 5 Dam

TOWN: Harwinton

COUNTY AND STATE: Litchfield County, Connecticut

STREAM: Tributary to the Poland River

DATE OF INSPECTION: May 6, 1980

BRIEF ASSESSMENT

Bristol Reservoir No. 5, a storage reservoir for public water supply, is impounded by a main dam located on the south side of the reservoir and a dike located on the west side. The main dam consists of an earth embankment with a top width of 8 feet, a maximum height of 60 feet, and a length of 640 feet. The dike consists of an earth embankment with a top width of 7 feet, a maximum height of 10 feet, and an overall length of 740 feet, including a 30 foot long concrete ogee spillway located near the left end of the dike. There is a 120 foot long natural spillway to the right of the dike. The elevation of the top of the dike is approximately 2 feet lower than the top of the dam and 0.5 feet above the natural spillway. The outlet works located at the center of the dam consist of a 48-inch corrugated metal pipe through the dam originating at an upstream gatehouse and discharging to a natural stream at the downstream toe of the dam.

Based on the visual inspection, the dam and dike are judged to be in good condition. Features that could affect the future integrity of the dam and dike are seepage exiting downstream of the dam, possible deterioration of the 48-inch outlet pipe, continued erosion of the spillway discharge channel, and the presence of large trees along the toe of the dike.

The dam is classified as "Intermediate" in size, with a "High" hazard potential. A Test Flood equal to the Probable Maximum Flood (PMF) was selected in accordance with the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams. The Test Flood inflow of 2,350 cfs results in a Test Flood routed outflow of 1,970 cfs which overtops the dike by 0.3 feet.

The spillway capacity with the water level at the top of the dike is 1,050 cfs and is equal to 53 percent of the Test Flood routed outflow.

It is recommended that a qualified, registered engineer be retained to investigate the seepage exiting downstream of the dam; to investigate the condition of the 48-inch outlet pipe; to perform a detailed hydrologic and hydraulic analysis in order to determine the need for and means to provide additional project discharge capacity; to design repairs to the spillway discharge channel; and to oversee tree removal along the toe of the dike. In addition, the dam and dike should be inspected every two years by a qualified, registered engineer, an operations and maintenance manual should be prepared and a formal warning system put into effect.

The owner should implement these recommendations as described herein and in greater detail in Section 7 of the Report within two years after receipt of this Phase I Inspection Report.

Ronald G. Litke, P.E.
Project Engineer

Roald Haestad
President

This Phase I Inspection Report on Bristol Reservoir No. 5 Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

ARAMAST MANTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRIAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the

condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety of the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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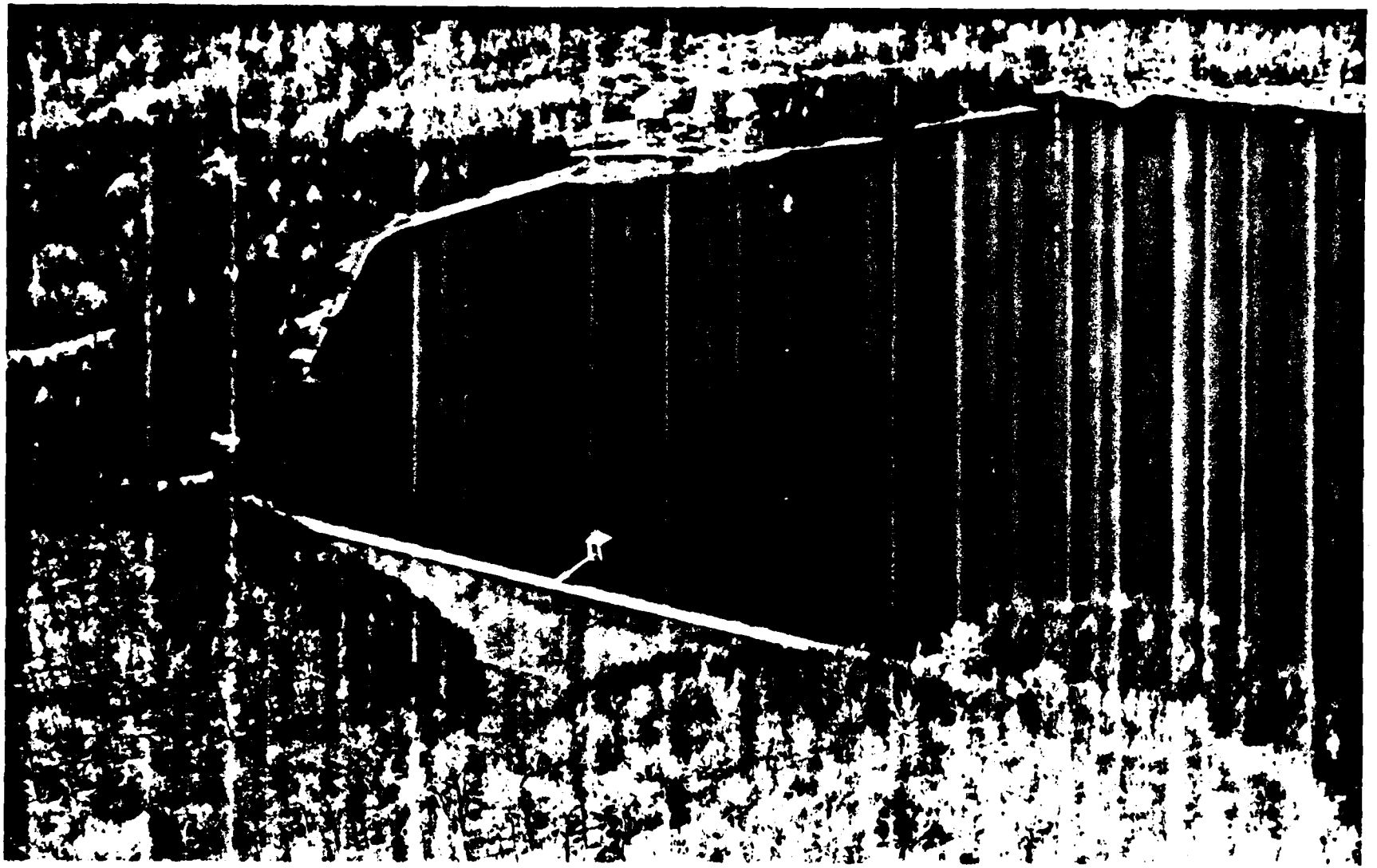
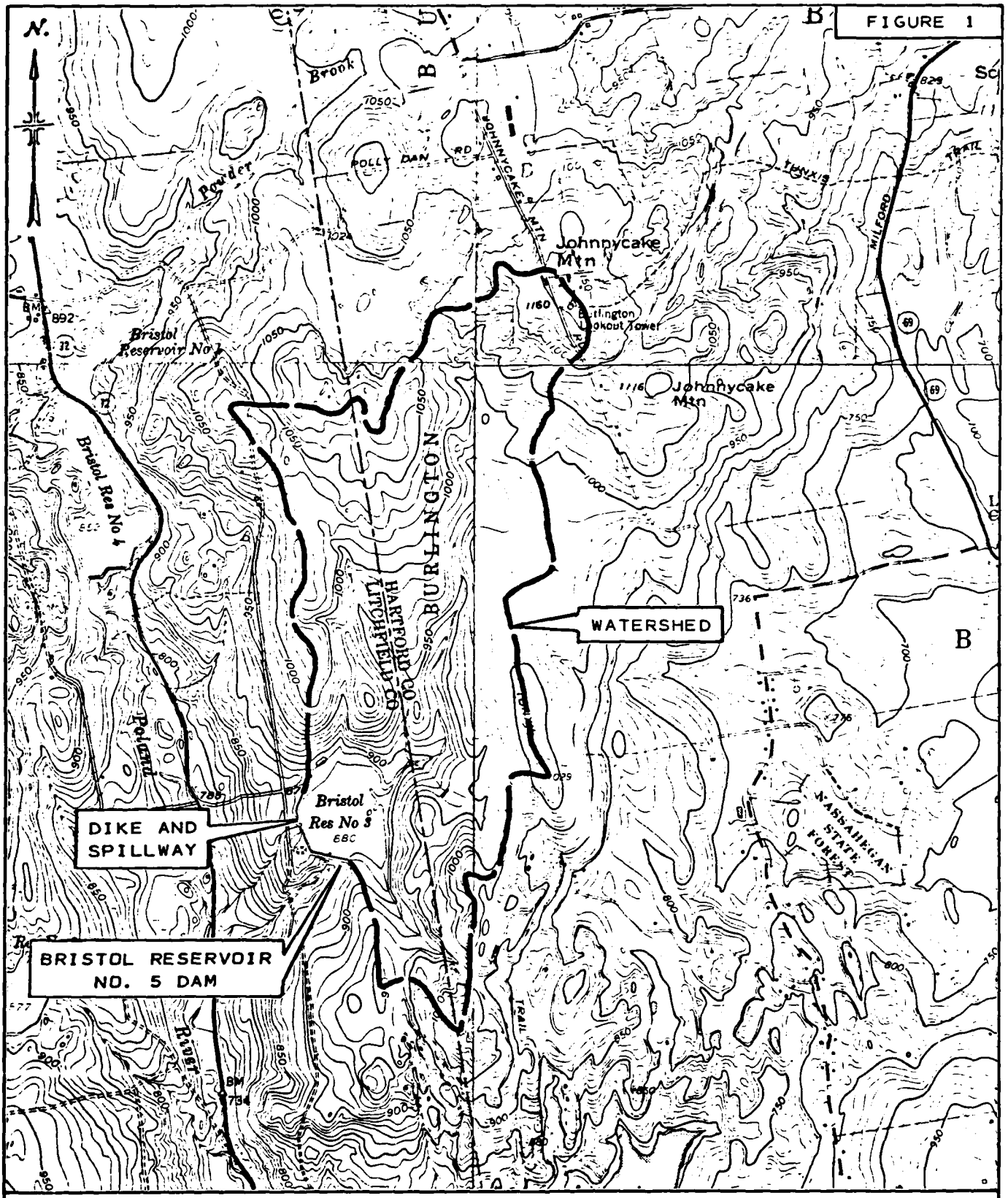


OVERVIEW PHOTO

U.S ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RESERVOIR NO. 5 - CT 00366
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		TRIBUTARY TO POLAND RIVER
		HARWINTON, CONNECTICUT — 19 APRIL '80



LOCATION PLAN

BRISTOL RESERVOIR NO. 5 DAM
HARWINTON, CONNECTICUT

SCALE: 1" = 2000'

ROALD HAESTAD, INC.

THOMASTON QUADRANGLE 1972

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

PROJECT INFORMATION
SECTION 1

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Roald Haestad, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Roald Haestad, Inc., under a letter of April 14, 1980, from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0048 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

The purposes of the program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interest.
2. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.
3. To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

The dam is located on an unnamed tributary to the Poland River, approximately 1,500 feet east of Connecticut Route 72 in the southeast section of Harwinton, Connecticut. The dam is shown on the Thomaston Quadrangle Map having coordinates of latitude N 41° 43.8' and longitude W 73° 00.5'. (The dam is incorrectly labeled Bristol Reservoir No. 3 on the Thomaston Quadrangle Map.)

b. Description of Dam and Appurtenances

The reservoir is impounded by a main dam located on the south side of the reservoir and a dike located on the west side. The main dam consists of an earth embankment with a top width of 8 feet, a maximum height of 60 feet and a length of 640 feet. Drawings indicate that the upstream slope is 2 horizontal to 1 vertical for the upper 18 feet of the dam, and 3 horizontal to 1 vertical for the remaining portion of the dam. The upstream slope is protected by 18 inches of riprap slope paving. The downstream slope is 2 horizontal to 1 vertical for the upper 31 feet of the dam, and 2.5 horizontal to 1 vertical for the remaining portion of the dam. A 6 foot wide berm and stone gutter is present at the change in slope on the downstream face. The downstream slope is protected by a well-maintained grass cover.

The earth embankment was constructed in two stages. There is no information available as to the composition of the original embankment constructed in 1921. In 1932 the dam was raised 10 feet by placing additional embankment material against the downstream slope and on the crest of the existing dam. Drawings indicate that

the new embankment material consisted of rolled hardpan and clay, with the exception of a zone of stone fill and porous material from the berm to the toe of the dam.

The outlet works located near the center of the main dam consist of a 48-inch corrugated metal pipe through the dam originating at an upstream gatehouse and discharging to a natural stream below the toe of the dam. Plans indicate that the corrugated metal pipe is encased in concrete. The flow through the outlet works is controlled by three (3) manually operated inlet gates located at varying elevations within the gatehouse.

The dike on the west side of the reservoir consists of an earth embankment with a top width of 7 feet, a maximum height of 10 feet, an overall length of 740 feet, an upstream slope of 2.3 horizontal to 1 vertical, and a downstream slope of 2 horizontal to 1 vertical. The upstream slope is protected by a well-maintained grass cover. The top of the dike is approximately 2 feet lower than the top of the dam. A 30 foot long concrete ogee spillway is located near the left end of the dike. The freeboard from spillway crest to the top of the dike is 4.5 feet. There is also a 120 foot long natural spillway to the right of the dike. The elevation of the natural spillway is approximately 0.5 feet below the top of the dike.

c. Size Classification

According to the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, a dam is classified as "Intermediate" in size if the height is between 40 feet and 100 feet or the dam impounds between 1,000 Acre-Feet and 50,000 Acre-Feet.

The dam has a maximum height of 60 feet and a maximum storage capacity of 866 Acre-Feet. Therefore, the dam is classified as "Intermediate" in size based upon the maximum height of 60 feet.

d. Hazard Classification - "High"

Based on the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the hazard classification of the dam is "High". A dam failure analysis indicates that Connecticut Route 72, located downstream of the dam, would be overtopped by as much as 18 feet as a result of the dam failure. Several homes would be flooded to a depth of about 1 foot above the sills and an industrial complex would also be flooded, possibly resulting in the loss of more than a few lives and property damage.

e. Ownership

Bristol Water Department
119 Riverside Street
Bristol, Connecticut 06010
John Burns, Superintendent
(203) 582-7431

f. Operator

Leonard Valentino
Bristol Filter Plant
Off of Clark Avenue
Bristol, Connecticut 06010
(203) 583-6504

g. Purpose of Dam

The dam and dike impound Bristol Reservoir No. 5, a storage reservoir for public water supply for the Bristol Water Department.

h. Design and Construction History

The dam was originally constructed in 1921. No information was available on the original design and construction of the dam. In 1932 the dam was raised 10 feet, as engineered by Metcalf

and Eddy, Consulting Engineers of Boston. Construction was done by local forces as a W.P.A. project. The surfaces of the spillway were gunited around 1974. In the fall of 1979 a concrete apron was added below the spillway. In 1980 crushed stone was placed in the spillway discharge channel to repair erosion caused by a March storm.

i. Normal Operational Procedures

Water is drawn from the reservoir through one of the two upper inlet gates, as required, to supply water to a downstream distribution reservoir.

1.3 Pertinent Data

a. Drainage Area

The drainage area consists of 1.1 square miles of "rolling" wooded terrain with no development.

b. Discharge at Damsite

Discharge at the damsite is over a 30-foot long concrete ogee spillway. The outlet works consist of a 48-inch outlet pipe originating at an upstream gatehouse and discharging at the downstream toe of the dam.

1.	Outlet Works (conduits) Size:	48-inch
	Invert Elevation @ Outlet:	825.8
	Discharge Capacity: (Top of Dam)	150 cfs
2.	Maximum Known Flood at Damsite:	125 cfs March 1980
3.	Ungated Spillway Capacity* at Top of Dike:	1,050 cfs
	Elevation:	884.5
4.	Ungated Spillway Capacity* at Test Flood Elevation:	1,255 cfs
	Elevation:	884.8
5.	Gated Spillway Capacity at Normal Pool Elevation:	N/A
	Elevation:	
6.	Gated Spillway Capacity at Test Flood Elevation:	N/A
	Elevation:	
7.	Total Spillway Capacity* at Test Flood Elevation:	1,255 cfs
	Elevation:	884.8
8.	Total Project Discharge* at Top of Dike:	1,050 cfs
	Elevation:	884.5
9.	Total Project Discharge* at Test Flood Elevation:	1,970 cfs
	Elevation:	884.8

*Including Main Spillway and Natural Spillway

c. Elevation - Feet Above Mean Sea Level (NGVD)

1.	Streambed at Toe of Dam:	825.8
2.	Bottom of Cutoff:	N/A
3.	Maximum Tailwater:	N/A
4.	Recreation Pool:	N/A
5.	Full Flood Control Pool:	N/A
6.	Spillway Crest:	880
7.	Design Surcharge - Original Design:	Unknown
8.	Top of Dam: 886.5 Dike:	884.5
9.	Test Flood Surcharge:	884.8

d. Reservoir - Length in Feet

1.	Normal Pool:	1,400 feet
2.	Flood Control Pool:	N/A
3.	Spillway Crest Pool:	1,400 feet
4.	Top of Dam:	1,500 feet
5.	Test Flood Pool:	1,500 feet

e. Storage - Acre-feet

1.	Normal Pool:	620 Acre-Feet
2.	Flood Control Pool:	N/A
3.	Spillway Crest Pool:	620 Acre-Feet
4.	Top of Dam:	866 Acre-Feet
5.	Test Flood Pool:	800 Acre-Feet

f. Reservoir Surface - Acres

1.	Normal Pool:	34 Acres
2.	Flood-Control Pool:	N/A
3.	Spillway Crest:	34 Acres
4.	Test Flood Pool:	40 Acres
5.	Top of Dam:	42 Acres

		Main Dam	Dike
g. Dam			
1.	Type:	Earth Embankment	Earth Embankment
2.	Length:	640 feet	740 feet
3.	Height:	60 feet	10 feet
4.	Top Width:	8 feet	7 feet
5.	Side Slopes:	D.S.-2 hor. to 1 ver. from top to berm; 2-1/2 hor. to 1 ver. from berm to toe. U.S.-2 hor. to 1 ver. for upper 18 feet of dam; 3 hor. to 1 ver. for remaining section.	D.S.-2 hor. to 1 ver. U.S.-2.3 hor. to 1 ver.
6.	Zoning:	Embankment consists of rolled hardpan and clay with a zone of stonefill and porous material located from the berm to the toe of the dam.	Unknown
7.	Impervious Core:	Unknown	Unknown
8.	Cutoff:	Unknown	Unknown
9.	Grout Curtain:	N/A	N/A
10.	Other:	N/A	N/A

h. Diversion and Regulating Tunnel - N/A

i. Spillway

1.	Type:	Concrete ogee spillway near left end of dike
2.	Length of Weir:	30 feet
3.	Crest Elevation with Flash Boards: without Flash Boards:	 N/A 880.0
4.	Gates:	N/A
5.	Upstream Channel:	N/A
6.	Downstream Channel:	Concrete Impact Blocks downstream of ogee section and riprap channel
7.	General:	Portion of riprap channel repaired with crushed stone

j. Regulating Outlets

1.	Invert at Gatehouse:	10" - 870.0 12" - 859.5 24" - 830.8
2.	Size:	10", 12" and 24"
3.	Description:	10" & 12" are high level inlets to gate chamber that discharge through 48-inch corrugated metal outlet pipe through dam. 24" is low level outlet or blowoff and also discharges through 48-inch outlet pipe.
4.	Control Mechanism:	Manually operated gate valves in upstream gatehouse.
5.	Other:	Total discharge capacity of 150 cfs.

ENGINEERING DATA
SECTION 2

2.1 Design Data

Design data consisted of a single plan entitled "Typical Section of Dam No. 5 Showing Method Used in Raising Dam 10 Feet, Metcalf and Eddy, June - November 1932". Reference is made to plans for the original dam constructed in 1921.

2.2 Construction Data

The dam was originally constructed in 1921 and raised 10 feet in 1932. No information other than the above-noted drawing was available on the construction of the dam. The raising of the dam in 1932 was reported to have been constructed by local forces as a W.P.A. project. The surfaces of the spillway were gunited around 1974. The concrete apron downstream of the spillway was added in the fall of 1979. Crushed stone was placed in the spillway discharge channel to repair erosion caused by a March 1980 storm.

2.3 Operation Data

Lake levels are recorded once a month, and do not necessarily coincide with maximum water levels. The amount of flow over the spillway during the August 1955 Storm is unknown because the dam was inaccessible during the storm.

2.4 Evaluation of Data

a. Availability

Existing data was provided by the Bristol Water Department.

b. Adequacy

The information that was available, along with the visual inspection, past performance history, and hydraulic and hydrologic calculations were adequate to assess the condition of the dam.

c. Validity

Field inspections and surveys revealed that the main dam was constructed substantially as shown on the 1932 Typical Section, with the exception that the top of the dam is appproximately 8 feet wide and not 16 feet as shown on the Typical Section.

VISUAL INSPECTION

SECTION 3

3.1 Findings

a. General

The visual inspection of the dam was conducted on May 6, 1980. At the time of the inspection the water level was approximately 1 foot below spillway elevation.

Bristol Reservoir No. 5 is impounded by a main embankment dam, Photo 1, and a dike along the right side of the reservoir, Photo 2. The outlet works are located near the center of the main dam, and an overflow spillway is located near the left end of the dike.

The general condition of the dam and dike at the time of inspection was good.

b. Dam

Main Embankment

The upstream slope of the earth embankment dam is covered with riprap slope paving to within 4.5 feet of the top of the dam. Plans for the dam indicate that the riprap was placed on a layer of screened gravel. The riprap is in good condition. Several minor downslope displacements, probably caused by wave action, were observed. Near the left end of the dam, a small 3 foot wide bench has been formed in the riprap approximately 2 feet above the water level, Photo 3.

There is a gravel roadway with a grassed median strip across the top of the dam, Photo 4. There were no visual indications of erosion or settlement.

The downstream slope is covered with a well maintained grass cover. A stone gutter and berm are present about 31 feet vertically below the crest, Photo 4. The slope above the berm elevation shows no indication of sloughing, erosion or seepage.

There are two 2-inch diameter iron pipes extending vertically from the downstream slope, see Figure 2A, page B-1 in Appendix B. The pipes appear to be observation wells and were reported to have been installed during the construction of the dam. The upper observation well could not be opened. The lower observation well was opened and a tape dropped down to the bottom, approximately 26.5 feet below ground surface. No water was present in the well.

Several animal burrows up to 4 inches in diameter and 2 inches deep were observed on the downstream slope below the berm. A 15 foot long by 4 foot wide erosion gully was observed along the contact with the right abutment approximately 20 feet above the toe of the slope, Photo 7. This erosion may be the result of large stones which may exist below the grass cover in contact with the right abutment.

A deteriorated concrete training wall, approximately 35 feet long, was observed along the left side of the discharge channel for the 48-inch outlet pipe, Photo 5. A seepage area approximately 5 feet by 10 feet was located near the toe of the dam adjacent to the concrete training wall, Photo 6. The flow was relatively clear with no visible evidence of turbidity. The area on the left side of the training wall was wet and soggy along the entire length of the wall. Another wet area was observed approximately 100 feet

downstream from the toe along the left bank of the discharge channel. The seepage at this location may be a result of groundwater flowing from the adjacent slope.

The toe of the slope to the right of the outlet works discharge is wet and soggy and contains moisture loving vegetation, Photo 8. Some water was observed seeping from the adjoining vertical bedrock escarpment which forms a portion of the right abutment. The flow was relatively clear with no visible evidence of turbidity.

Dike

To the right of the dam there is an earth dike, with a maximum height of 10 feet and an average height of about 5 feet. The crest and downstream slope are grass covered and very well maintained, Photo 2. Some undulation of the downstream slope may indicate past minor sloughing. The elevation of the top of the dike is approximately 2 feet lower than the top of the dam.

The upstream slope is protected with riprap slope paving to within 2.5 feet of the crest. The riprap is generally in good condition.

Immediately downstream of the toe there are numerous trees up to 10 inches in diameter.

A concrete spillway is located near the left end of the dike. Some minor erosion has occurred adjacent to the concrete training walls, Photo 9.

c. Appurtenant Structures

The appurtenant structures consist of the outlet works and service bridge at the main dam, and the overflow spillway located near the left end of the dike.

The concrete overflow spillway appeared to be in good condition. The surface was recently gunited. Some seepage through the overflow section was observed along a crack in the gunite near the right end of the spillway, Photo 10. The training walls are generally in good condition. There are concrete impact baffle blocks downstream of the spillway weir. A concrete apron beyond the baffle blocks appears to have been recently added. Undermining was observed at the upstream end of the apron near the right side of the spillway. Seepage was also observed near the downstream end of the apron.

The discharge channel is lined with hand-placed riprap. The left bank of the channel is inclined and faced with riprap. A section of the channel approximately 50 feet long washed out during a March 1980 storm. This section of the channel was repaired with crushed stone up to 8-inches in diameter, Photo 11.

The outlet works consist of a 48-inch corrugated metal pipe through the dam, originating at an upstream gatehouse and discharging to a natural stream at the downstream toe of the dam. The gatehouse appears to be in good condition with some minor deterioration of the concrete at the water line, Photo 12. There are three intake gates at various elevations within the gatehouse. The upper gate was open at the time of inspection, and all gates were reported to be operable.

There is some spalling of the concrete headwall at the discharge end of the 48-inch corrugated metal pipe, Photo 13. Two 4-inch tile pipes, one on each side of the 48-inch outlet pipe, were discharging a small amount of flow, Photo 13.

The service bridge from the dam to the gatehouse consists of a steel truss with a wood deck. The bridge appeared to be in good condition, Photo 12.

d. Reservoir Area

The shore of the reservoir is thickly wooded except for a clearing adjacent to a home near the right end of the dike. A portion of this area is approximately 0.5 feet lower than the top of the dik and acts as a natural spillway. Some slope erosion has occurred in the area between the dam and dike, Photo 14.

e. Downstream Channel

The downstream channel for the outlet works is the natural streambed. No significant obstructions to the flow were observed.

The downstream channel for the spillway was described under Section 3.1.c.

3.2 Evaluation

On the basis of the visual inspection, the dam is judged to be in good condition. The following observed features could affect the future integrity of the dam:

1. Slumping of the riprap in the vicinity of the left abutment of the dam and minor sloughing along the downstream face of the dike.

2. Animal burrows on the downstream embankment could lead to future erosion of the slope.

3. Seepage exiting along the toe and immediately downstream of the dam could lead to piping and erosion. The seepage immediately adjacent to the outlet structure headwall could represent leakage from the buried outlet pipe.

4. Potential increase in the deterioration of the floor of the spillway discharge channel can lead to undermining of the spillway weir and adjoining training walls.

5. Numerous large trees downstream of the dike could lead to the development of root systems extending through the dike cross section. The trees could uproot during a storm and cause damage to the embankment.

OPERATIONAL AND MAINTENANCE PROCEDURES
SECTION 4

4.1 Operational Procedures

a. General

Water is drawn from the reservoir through the 48-inch outlet pipe by opening one of the two upper inlet gates in the gatehouse. The gates are operated as required to maintain the flow of water to a downstream distribution reservoir.

b. Description of Any Warning System in Effect

There is no formal warning system in effect. The dam is monitored during heavy rain and gates are opened as required.

4.2 Maintenance Procedures

a. General

Normal maintenance procedures consist of regular mowing and the application of fertilizer and lime to the grassed areas of the dam and dikes. Portions of the spillway discharge channel have recently been repaired following washouts during the month of March 1980.

b. Operating Facilities

The valve operators within the gatehouse are greased regularly, and repairs made as needed.

4.3 Evaluation

Present operations and maintenance procedures are adequate and should remain in effect. An operations and maintenance manual should be prepared for the dam and operating facilities, and inspections should be made by qualified, registered engineers every two years.

The warning system which is currently in effect should be formalized and should include monitoring of the dam during extremely heavy rains and procedures for notifying downstream authorities in the event of an emergency.

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES
SECTION 5

5.1 General

Bristol Reservoir No. 5 is impounded by a main dam located on the south side of the reservoir and a dike located on the west side. The spillway is a 30 foot long concrete ogee section with a downstream concrete apron and concrete impact baffle blocks (See Figure 2B, page B-2). The spillway is located near the left end of the dike. There is a natural spillway approximately 120 feet in length consisting of a paved roadway and grassed area to the right of the dike. There is 4.5 feet of freeboard from spillway crest to the top of the dike. The top of the dike is approximately two feet lower than the top of the main dam and 0.5 feet higher than the natural spillway.

The dam has a tributary watershed of 1.1 square miles. The terrain is "rolling" wooded hills with no development. The watershed has a maximum elevation of 1170 feet at the northern end and an elevation of 880 feet at spillway.

The outlet works consist of a 48-inch outlet pipe through the main dam originating at an upstream gatehouse and discharging at the downstream toe. In the gatehouse a 10-inch and a 12-inch high level inlet, and a 24-inch low level outlet or blowoff discharge into the gate chamber and through the 48-inch outlet pipe. The outlet works have a combined discharge capacity of 150 cfs.

5.2 Design Data

A typical section of Bristol Reservoir No.5 was available. The section shows the raising of the dam 10 feet in 1932, and the piping within the gate chamber.

5.3 Experience Data

The maximum known flood in recent years occurred in March, 1980, when the depth of flow over the spillway was reported to be 14 inches, equivalent to a flow of 125 cfs. During the 1955 flood the area was inaccessible because of downstream flooding and the maximum flow at that time is unknown.

5.4 Test Flood Analysis

Based on the dam failure analysis, the dam is classified as "High" hazard potential. The dam is classified as "Intermediate" in size based on a height of 60 feet and storage capacity of 866 Acre-Feet. According to the Recommended Guidelines for Safety Inspection of Dams, by the Corps of Engineers, the Test Flood should be the Probable Maximum Flood (PMF). The Test Flood was calculated using a peak flow of 2,125 cubic feet per second per square mile (csm), from the minimum 2 square mile drainage area shown on the guide curves supplied by the Corps of Engineers, and 1.1 square mile watershed of Bristol Reservoir No. 5. The peak inflow calculated to be 2,350 cfs results in a routed outflow of 1,970 cfs that would overtop the dike by 0.3 feet. The flood routing through the reservoir was done in accordance with "Estimating Effect of Surcharge Storage on Maximum Probable Discharges" provided by the Corps of Engineers.

The spillway capacity including the natural spillway was calculated to be 1,050 cfs or 53 percent of the Test Flood routed outflow.

5.5 Dam Failure Analysis

A dam failure analysis was made using the "Rule of Thumb" guidance provided by the Corps of Engineers. Failure was assumed when the water level reached the top of the dam.

The dam breach would release up to 64,100 cfs into the stream below the dam. The flood wave would travel in a deep and narrow gorge for a distance of 1,600 feet downstream before the topography changes to a flatter slope and wider channel. Connecticut Route 72 would be inundated for much of its length between the spillway brook crossing and section No. 11, see Figure 5 in Appendix D. Depths of overtopping varied up to a maximum of 18 feet. The capacities of the culverts were neglected in the analysis as they were insignificant compared to the flood flows.

A residential structure located at the intersection of East Church Road and Connecticut Route 72 would be flooded to a depth of about 1 foot above the sill. Further downstream the flood wave would overtop Preston Road by about 10 feet and U.S. Route 6 by about 2 feet. Bristol Reservoir No. 2, a small reservoir south of Preston Road, would be overtopped by the maximum spillway discharge of 1640 cfs from Reservoir No. 5 prior to failure of Reservoir No. 5 Dam. Houses in this reach and below U.S. Route 6 would suffer cellar flooding and some possible flooding of living areas. A large industrial complex along Connecticut Route 72 would be inundated to a depth of about 2 feet.

The stream channel can accomodate the maximum spillway discharge of 1640 cfs prior to dam failure with minor overtopping

of Connecticut Route 72, but no flooding of homes.

The dam is classified as "High" hazard potential because of the possible loss of more than a few lives and downstream property damage should the dam fail.

EVALUATION OF STRUCTURAL STABILITY

SECTION 6

6.1 Visual Observation

The visual inspection did not disclose any indications of structural instability.

6.2 Design and Construction Data

The design and construction data consisted of a single plan entitled "Typical Section of Dam No. 5 Showing Method Used in Raising Dam 10 Feet, Metcalf and Eddy, June - November 1932". Reference is made to plans for the original dam constructed in 1921. No information is presented on the type of soil used in the earth embankment other than a note that rolled hardpan and clay were used in raising the dam. The available data is not sufficient to perform a formal stability analysis.

6.3 Post Construction Changes

No known post construction changes have been made since the 1932 raising of the dam.

6.4 Seismic Stability

The dam and dike are located in Seismic Zone 1 and, in accordance with the recommended Phase I guidelines, does not warrant seismic stability analysis.

7.1 Dam Assessment

a. Condition

On the basis of the visual inspection, the dam is judged to be in good condition. The future integrity of the dam could be affected by:

1. Seepage exiting downstream of the dam.
2. Deterioration of the 48-inch corrugated metal outlet pipe through the dam.
3. Deterioration of the floor of the spillway discharge channel.
4. Trees growing along the toe of the dike.

An evaluation of the hydraulic and hydrologic features of the dam determined that the spillway is capable of passing 40 percent of the Test Flood routed outflow before overtopping the natural spillway. Including the natural spillway, the total project discharge capacity is equal to 53 percent of the Test Flood routed outflow.

b. Adequacy of Information

The information available was sufficient for performing a Phase I Inspection.

c. Urgency

The recommendations presented in Section 7.2 and 7.3 should be carried out by the owner within two years of receipt of this report.

7.2 Recommendations

The following recommendations should be carried out u the direction of a qualified, registered engineer:

1. Investigate the significance of the seepage observed lc the toe and downstream of the dam; in particular, whether the seepage in the area of the outlet structure is related to leakage from or around the buried outlet pipe. Design and construct seepage control and/or monitoring measures as needed.

2. Investigate the condition of the corrugated metal outlet pipe and make any necessary repairs.

3. Perform a detailed hydrologic and hydraulic analysis to determine the need for and means to provide additional project discharge capacity.

4. Design and construct repairs to the floor of the spillway discharge channel.

5. The large trees along the downstream toe of the dike should be cut and the stumps removed. The root zones should be backfilled with selected soils.

6. Investigate the significance of the slumping of the riprap near the left end of the main dam and the minor sloughing on the downstream slope of the dike; and design repairs as required.

The owner should comply with all of the engineers' recommendations based upon the findings of the above investigations.

7.3 Remedial Measures

a. Operation and Maintenance Procedures

1. A program of biennial technical inspections by a qualified, registered engineer should be instituted. The inspection

should include monitoring of the quantity and turbidity of the seepage in accordance with the program developed under Section 7.2, Item 1.

2. Animal burrows on the downstream slope of the dam should be backfilled with select material.

3. Erosion gullies adjacent to the spillway training walls and near the toe of the dam adjacent to the contact with the right abutment should be repaired.

4. An operations and maintenance manual should be prepared for the dam and operating facilities.

5. A formal warning system should be put into effect and should include monitoring of the dam during heavy rains and procedures for notifying downstream authorities in the event of an emergency.

7.4 Alternatives

There are no practical alternatives to the above recommendations.

APPENDIX A

VISUAL CHECK LIST WITH COMMENTS

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT: Bristol Reservoir No. 5 Dam

DATE: May 6, 1980 TIME: 8:15 a.m. WEATHER: Sunny - 65°

W.S. ELEVATION: 879.0 (1' Below Spillway) U.S. N/A DN.S

	PARTY	DISCIPLINE
1.	Roald Haestad, P.E. - Roald Haestad, Inc.	Civil Engineer
2.	Ronald G. Litke, P.E. - Roald Haestad, Inc.	Civil Engineer
3.	Donald L. Smith, P.E. - Roald Haestad, Inc.	Civil/Hydrologist
4.	Richard Murdock, P.E. - Geotechnical Engineers, Inc.	Geotechnical Engineer
5.		
6.		

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam Embankment	RGL, DLS, RM	Good condition
2.	Dike Embankment	RGL, DLS, RM	Good condition
3.	Outlet Works - Intake Channel & Structure	RGL, DLS, RM	Under water. Not observed.
4.	Outlet Works - Control Tower	RGL, DLS	Good condition
5.	Outlet Works - Transition & Conduit	RGL, DLS	48" corrugated metal pipe
6.	Outlet Works - Outlet Structure & Channel	RGL, DLS, RM	Fair condition
7.	Outlet Works - Spillway Weir, Appr. & Dis.	RGL, DLS, RM	Good condition. Discharge channel recently repaired.
8.	Outlet Works - Service Bridge	RGL, DLS	Good condition
9.			
10.			
11.			
12.			

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 5 Dam DATE: 5/6/80

PROJECT FEATURE: Dam Embankment NAME: RGL, DLS

DISCIPLINE: Civil and Geotechnical Engineers NAME: RM

AREA ELEVATION	CONDITIONS
DAM EMBANKMENT	
CREST ELEVATION	886.5
CURRENT POOL ELEVATION	879.0
MAXIMUM IMPOUNDMENT TO DATE	881.2
SURFACE CRACKS	None observed
PAVEMENT CONDITION	Good, grass and gravel road
MOVEMENT OR SETTLEMENT OF CREST	None observed
LATERAL MOVEMENT	None observed
VERTICAL ALIGNMENT	Good
HORIZONTAL ALIGNMENT	Good
CONDITION AT ABUTMENT AND AT CONCRETE STRUCTURES	Good
INDICATIONS OF MOVEMENT OF STRUCTURAL ITEMS ON SLOPES	None observed
TRESPASSING ON SLOPES	None
VEGETATION ON SLOPES	Well maintained grass slopes
SLOUGHING OR EROSION OF SLOPES OR ABUTMENTS	Minor sloughing and erosion on slope
ROCK SLOPE PROTECTION - RIPRAP FAILURES	Riprap generally in good condition, appears displaced for approximately 15' near left end of dam.
UNUSUAL MOVEMENT OR CRACKING AT OR NEAR TOES	None observed
UNUSUAL EMBANKMENT OR DOWNSTREAM SEEPAGE	Seepage at toe of slope on both sides of outlet works headwall.
PIPING OR BOILS	None observed
FOUNDATION DRAINAGE FEATURES	None observed
TOE DRAINS	None observed
INSTRUMENTATION SYSTEM	None

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 5 Dam DATE: 5/6/80

PROJECT FEATURE: Dike Embankment NAME: RGL,DLS

DISCIPLINE: Civil and Geotechnical Engineers NAME: RM

AREA EVALUATED	CONDITIONS
DIKE EMBANKMENT	
CREST ELEVATION	884.5
CURRENT POOL ELEVATION	879.0
MAXIMUM IMPOUNDMENT TO DATE	881.2
SURFACE CRACKS	None observed
PAVEMENT CONDITION	Good grassed surfaces
MOVEMENT OR SETTLEMENT OF CREST	None observed
LATERAL MOVEMENT	None
VERTICAL ALIGNMENT	Good
HORIZONTAL ALIGNMENT	Good
CONDITIONS AT ABUTMENT AND AT CONCRETE STRUCTURES	Some minor erosion adjacent to spillway training walls.
INDICATIONS OF MOVEMENT OF STRUCTURAL ITEMS ON SLOPES	None
TRESPASSING ON SLOPES	None
VEGETATION ON SLOPES	Well maintained grass cover on crest and downstream slope. Extensive tree growth along downstream toe.
SLOUGHING OR EROSION OF SLOPES OR ABUTMENTS	Some erosion adjacent to spillway training walls.
ROCK SLOPE PROTECTION - RIPRAP FAILURE	Good condition
UNUSUAL MOVEMENT OR CRACKING AT OR NEAR TOES	None
UNUSUAL EMBANKMENT OR DOWNSTREAM SEEPAGE	None
PIPING OR BOILS	None
FOUNDATION DRAINAGE FEATURES	None
TOE DRAINS	None
INSTRUMENTATION SYSTEM	None

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 5 Dam DATE: 5/6/80

PROJECT FEATURE: Outlet Works - Intake Channel and Intake Structure NAME: RGL,DLS

DISCIPLINE: Civil and Geotechnical Engineers NAME: RM

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	Below Reservoir surface and not observed.
A. APPROACH CHANNEL:	
SLOPE CONDITIONS	
BOTTOM CONDITIONS	
ROCK SLIDES OR FALLS	
LOG BOOM	
DEBRIS	
CONDITION OF CONCRETE LINING	
DRAINS OR WEEP HOLES	
B. INTAKE STRUCTURE:	
CONDITION OF CONCRETE	
STOP LOGS AND SLOTS	

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 5 Dam DATE: 5/6/80

PROJECT FEATURE: Outlet Works - Control Tower NAME: RGL

DISCIPLINE: Civil Engineers NAME: DLS

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
A. CONCRETE AND STRUCTURAL:	
GENERAL CONDITION	Good
CONDITION OF JOINTS	None observed
SPALLING	None observed on interior. Some minor spalling of exterior at water line.
VISIBLE REINFORCING	None observed
RUSTING OR STAINING OF CONCRETE	None observed
ANY SEEPAGE OR EFFLORESCENCE	Some efflorescence below water line on interior walls.
JOINT ALIGNMENT	No joints observed
UNUSUAL SEEPAGE OR LEAKS IN GATE CHAMBER	None observed (entire chamber was not observed, as intake gates were open at the time of inspection).
CRACKS	None observed
RUSTING OR CORROSION OF STEEL	Extension stems on gates rusted.
B. MECHANICAL AND ELECTRICAL:	
AIR VENTS	N/A
FLOAT WELLS	N/A
CRANE HOIST	N/A
ELEVATOR	N/A
HYDRAULIC SYSTEM	N/A
SERVICE GATES	Reported operable.
EMERGENCY GATES	N/A
LIGHTNING PROTECTION SYSTEM	N/A
EMERGENCY POWER SYSTEM	N/A
WIRING AND LIGHTING SYSTEM IN GATE CHAMBER	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 5 Dam DATE: 5/6/80

PROJECT FEATURE: Outlet Works - Transition & Conduit NAME: RGL

DISCIPLINE: Civil Engineers NAME: DLS

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	48" corrugated metal pipe through dam.
GENERAL CONDITION OF CONCRETE	
RUST OR STAINING ON CONCRETE	
SPALLING	
EROSION OR CAVITATION	
CRACKING	
ALIGNMENT OF MONOLITHS	
ALIGNMENT OF JOINTS	
NUMBERING OF MONOLITHS	

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 5 Dam DATE: 5/6/80

PROJECT FEATURE: Outlet Works - Outlet Structure and Outlet Channel NAME: RGL,DLS

DISCIPLINE: Civil and Geotechnical Engineers NAME: RM

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
GENERAL CONDITION OF CONCRETE	Fair
RUST OR STAINING	Rust stains and deposits at outlet of 4" drain pipe on either side of outlet pipe
SPALLING	Surficial spalling at top and ends of headwall.
EROSION OR CAVITATION	None observed
VISIBLE REINFORCING	None observed
ANY SEEPAGE OR EFFLORESCENCE	Minor efflorescence observed. Seepage from drain pipes.
CONDITION AT JOINTS	No joints observed.
DRAIN HOLES	None
CHANNEL	Natural streambed
LOOSE ROCK OR TREES OVERHANGING CHANNEL	A few overhanging trees.
CONDITION OF DISCHARGE CHANNEL	Good. Some large boulders located in channel.

OTHER:

Concrete training wall to left of outlet channel badly deteriorated.

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 5 Dam DATE: 5/6/80

PROJECT FEATURE: Spillway Weir, Approach Outlet Works - & Discharge Channel NAME: RGL,DLS

DISCIPLINE: Civil and Geotechnical Engineers NAME: RM

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
A. APPROACH CHANNEL:	
GENERAL CONDITION	Good
LOOSE ROCK OVERHANGING CHANNEL	None
TREES OVERHANGING CHANNEL	None
FLOOR OF APPROACH CHANNEL	Concrete floor below reservoir surface
B. WEIR AND TRAINING WALLS:	
GENERAL CONDITION OF CONCRETE	Fair. Some surface cracks on gunite.
RUST OR STAINING	None observed
SPALLING	Some minor spalling.
ANY VISIBLE REINFORCING	Wire mesh from gunite exposed in one area.
ANY SEEPAGE OR EFFLORESCENCE	Some efflorescence. Seepage through spillway near left end.
DRAIN HOLES	None observed
C. DISCHARGE CHANNEL:	
GENERAL CONDITION	Evidence of erosion in the past. Crushed stone placed recently in one area.
LOOSE ROCK OVERHANGING CHANNEL	None
TREES OVERHANGING CHANNEL	Some trees in the vicinity of the channel.
FLOOR OF CHANNEL	Riprap blocks and crushed stone
OTHER OBSTRUCTIONS	Bridge downstream.

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 5 Dam DATE: 5/6/80

PROJECT FEATURE: Outlet Works - Service Bridge NAME: RGL

DISCIPLINE: Civil Engineers NAME: DLS

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	
A. SUPER STRUCTURE:	
BEARINGS	None. Beams cast into abutment and control tower.
ANCHOR BOLTS	None
BRIDGE SEAT	None
LONGITUDINAL MEMBERS	Rusted
UNDER SIDE OF DECK	Good
SECONDARY BRACING	Rusted
DECK	Wood in good condition.
DRAINAGE SYSTEM	N/A
RAILINGS	Good condition
EXPANSION JOINTS	N/A
PAINT	Fair
B. ABUTMENT AND PIERS:	
GENERAL CONDITION OF CONCRETE	Some cracking at what appears to be surface coating of mortar.
ALIGNMENT OF ABUTMENT	Good
APPROACH TO BRIDGE	Good
CONDITION OF SEAT AND BACKWALL	No seat or backwall

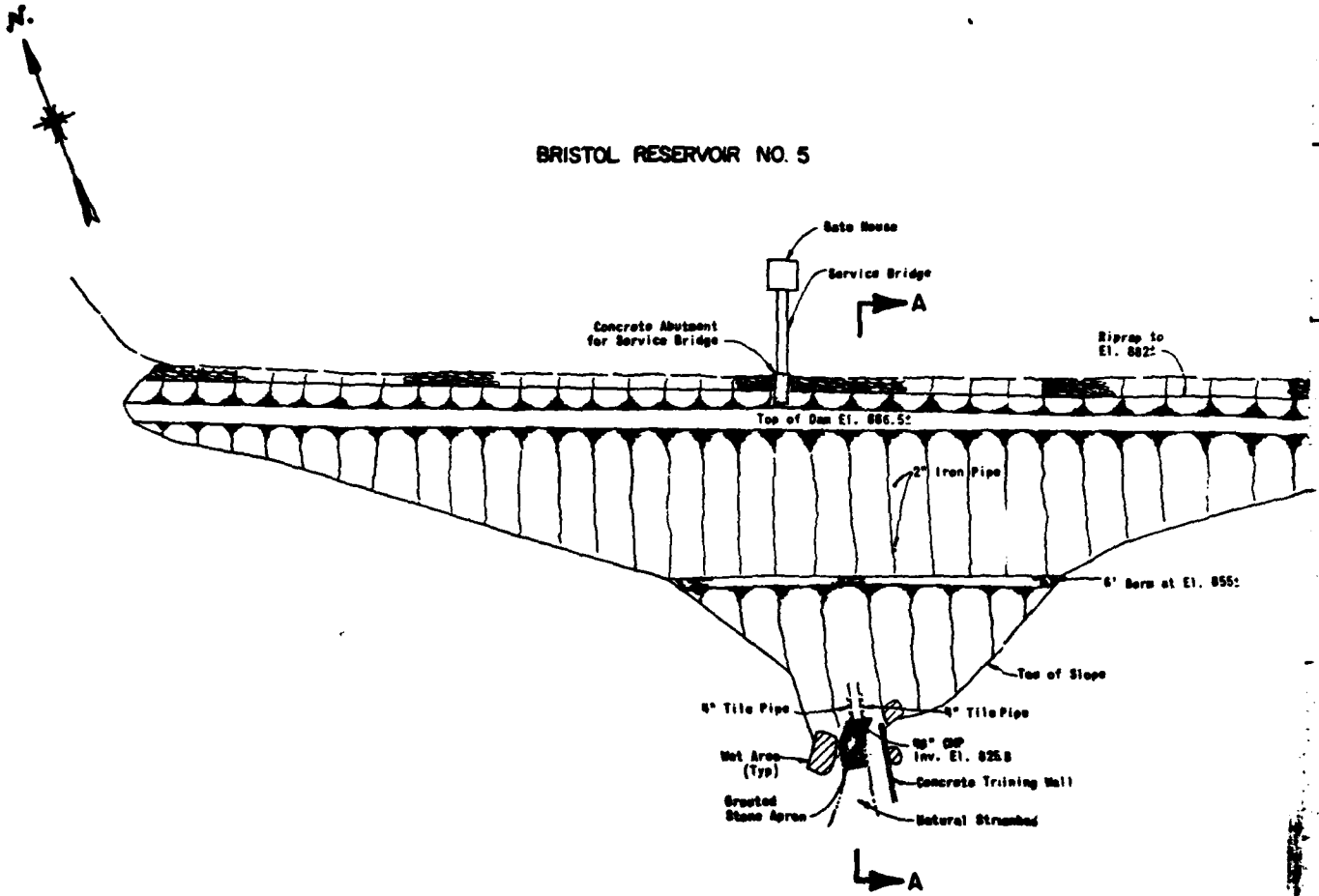
APPENDIX B

ENGINEERING DATA

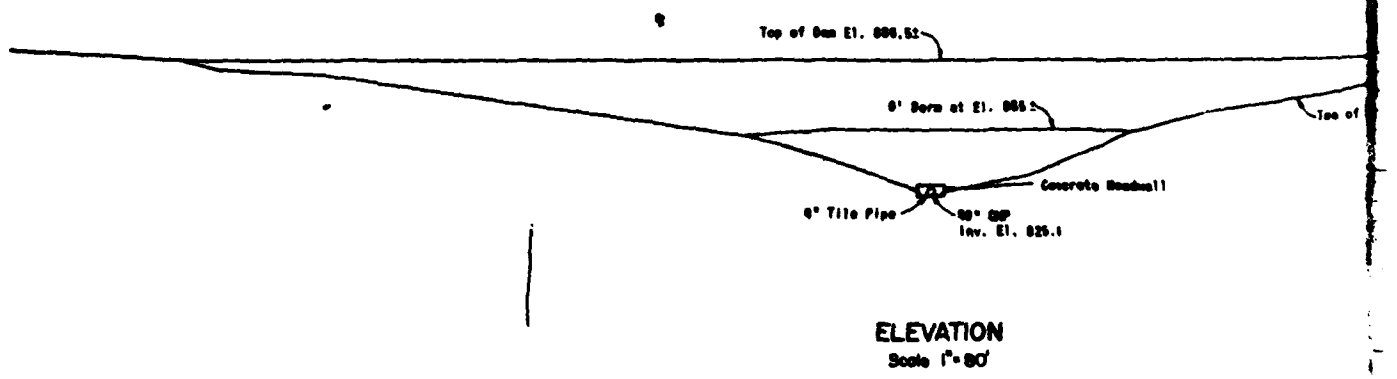
LIST OF REFERENCES

1. Plan, "Typical Section of Dam No. 5 Showing Method Used in Raising Dam 10 Feet, Metcalf and Eddy, June - November 1932."

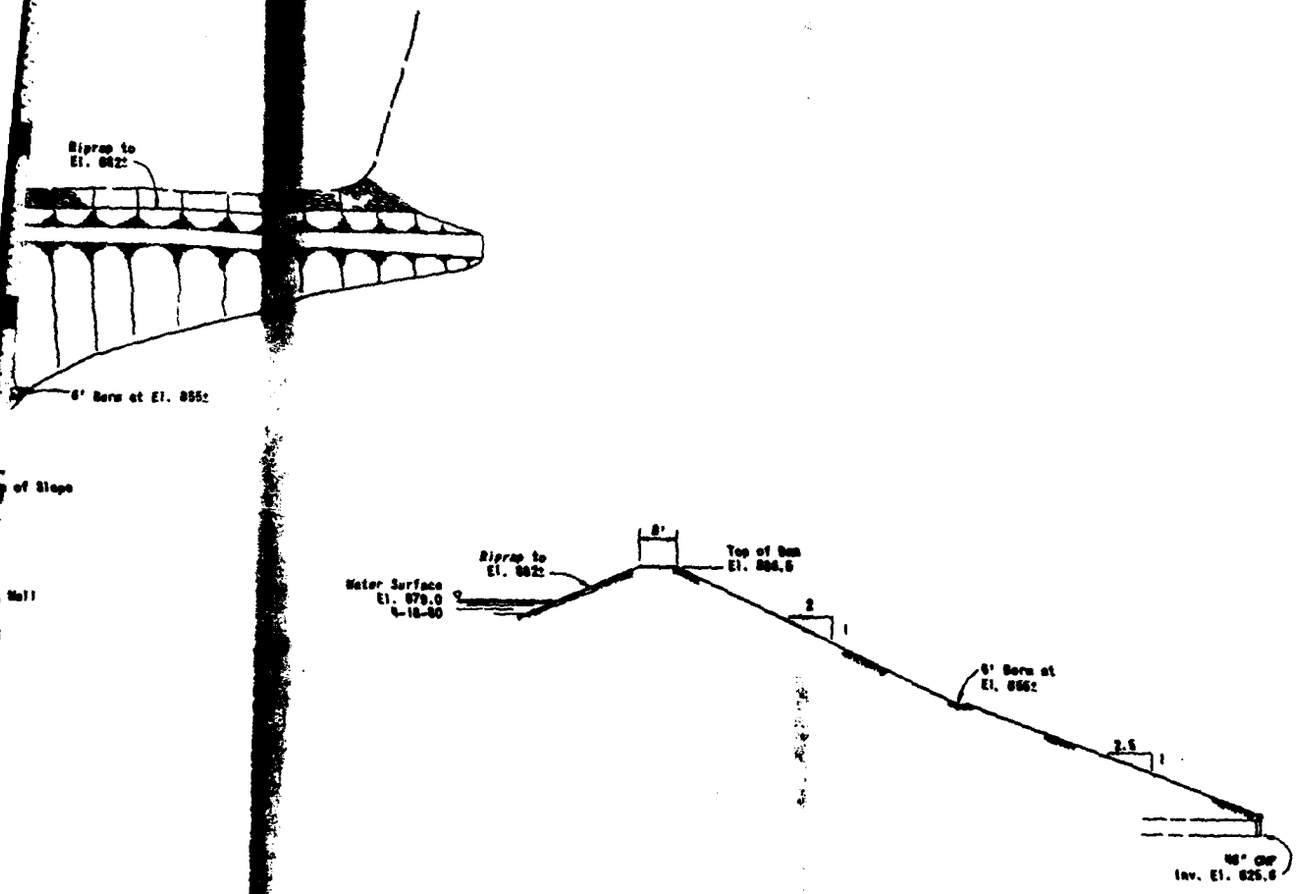
BRISTOL RESERVOIR NO. 5



PLAN
Scale 1"=80'

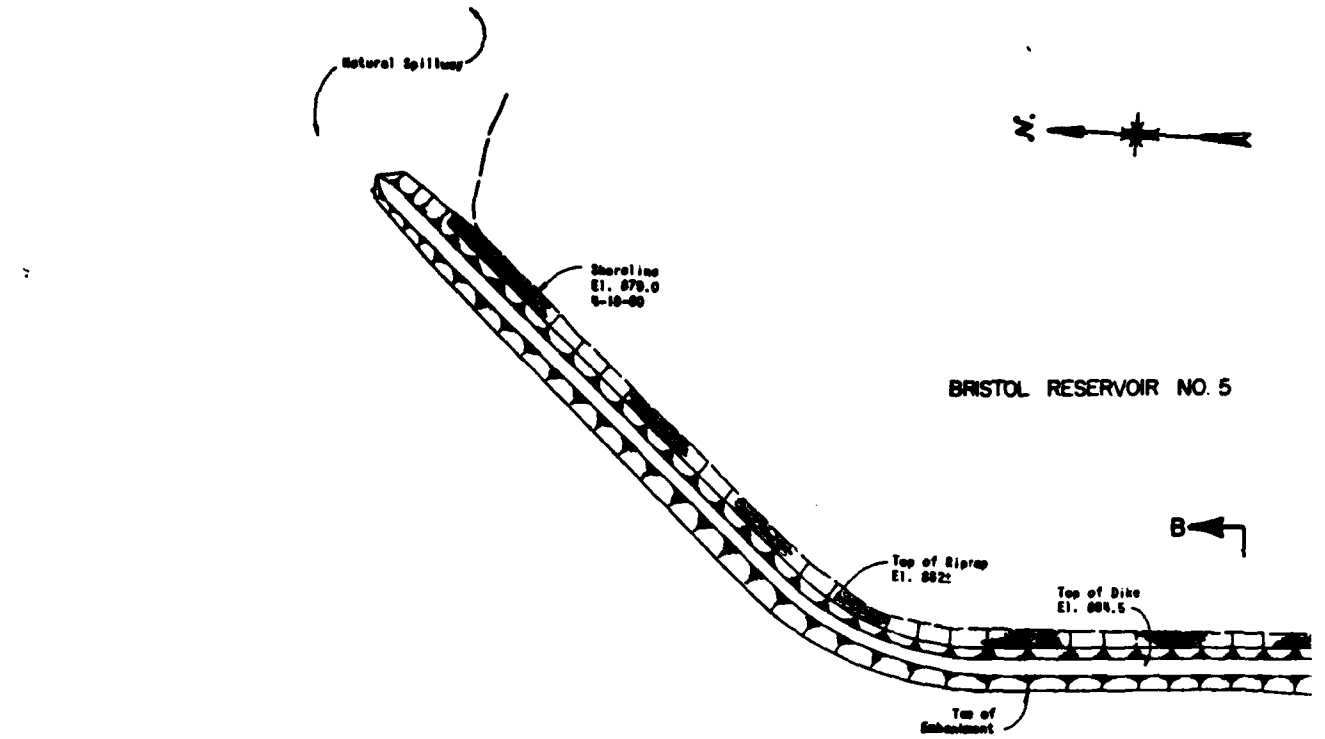


ELEVATION
Scale 1"=80'



SECTION A-A
Scale 1"=40'

RONALD HAESTAD, INC. *CONSULTING ENGINEERS* WATERBURY, CONNECTICUT		U.S. ARMY ENGINEER DIV. NEW ENGLAND *CORPS OF ENGINEERS* WALTHAM, MASS.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
BRISTOL RESERVOIR NO. 5 MAIN DAM			
DRAWN	CHECKED	APPROVED	SCALES AS NOTED
JRS	RGL	RH	DATE JULY 1980 PAGE 9-1



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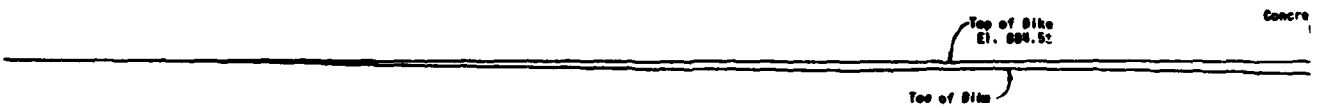
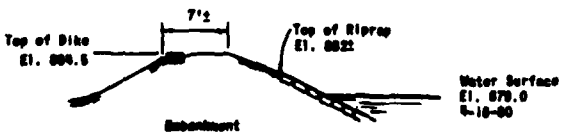


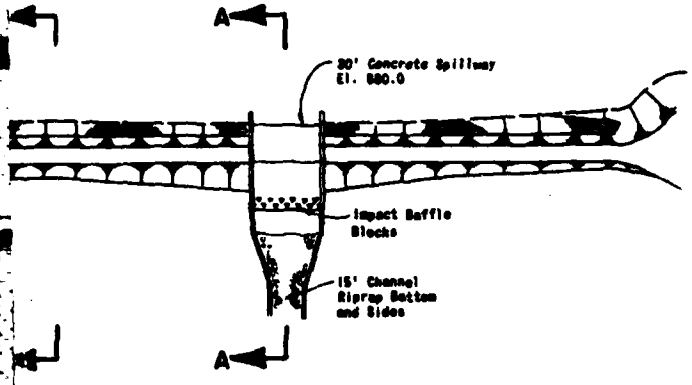
ELEVATION
Scale 1"=80'

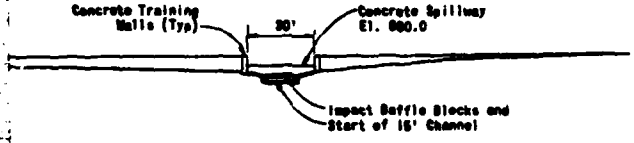


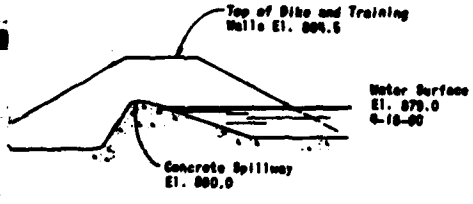
SECTION B-B
Scale 1"=20'

SECTION A-
Scale 1"=20'

FIGURE 2B







CTION A-A
Scale 1"=20'

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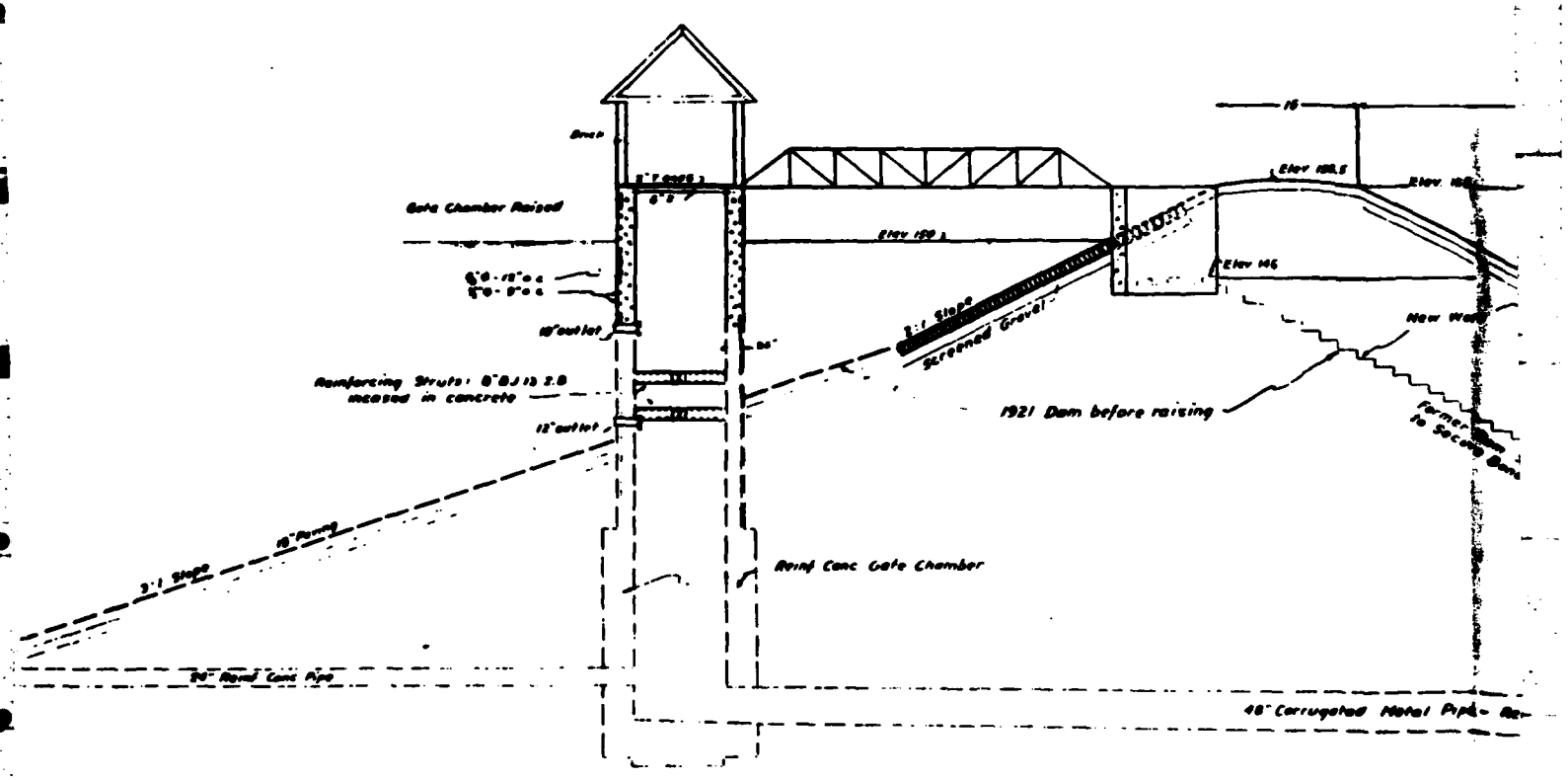
BRISTOL RESERVOIR NO. 5
DIKE AND SPILLWAY

DRAWN	CHECKED	APPROVED	SCALES AS NOTED

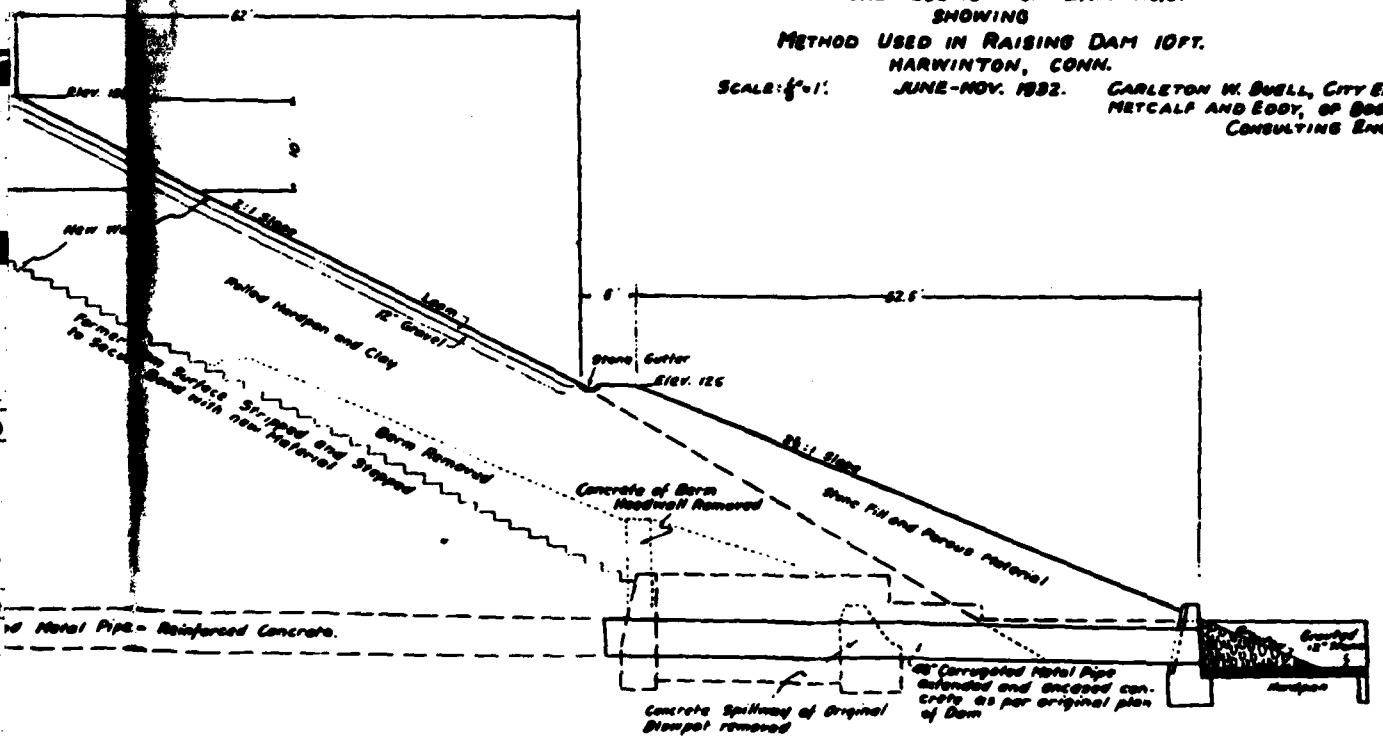

Gate Chamber Raised
Elev 189.5
Elev 146
3:1 Slope
Screened Gravel
New Wall
1921 Dam before raising
Reinforcing Struts
embedded in concrete
18" outlet
15" outlet
3:1 Slope
Reinf Conc Gate Chamber
30" Reinf Conc Pipe
48" Corrugated Metal Pipe

5-A-6

BRISTOL WATER DEPARTMENT

TYPICAL SECTION OF DAM No. 5.
SHOWING
METHOD USED IN RAISING DAM 10FT.
HARWINTON, CONN.

SCALE: 1"=1'. JUNE-NOV. 1932. CARLETON W. BUELL, CITY ENGR.
METCALF AND EDDY, OF BOSTON,
CONSULTING ENGRS.



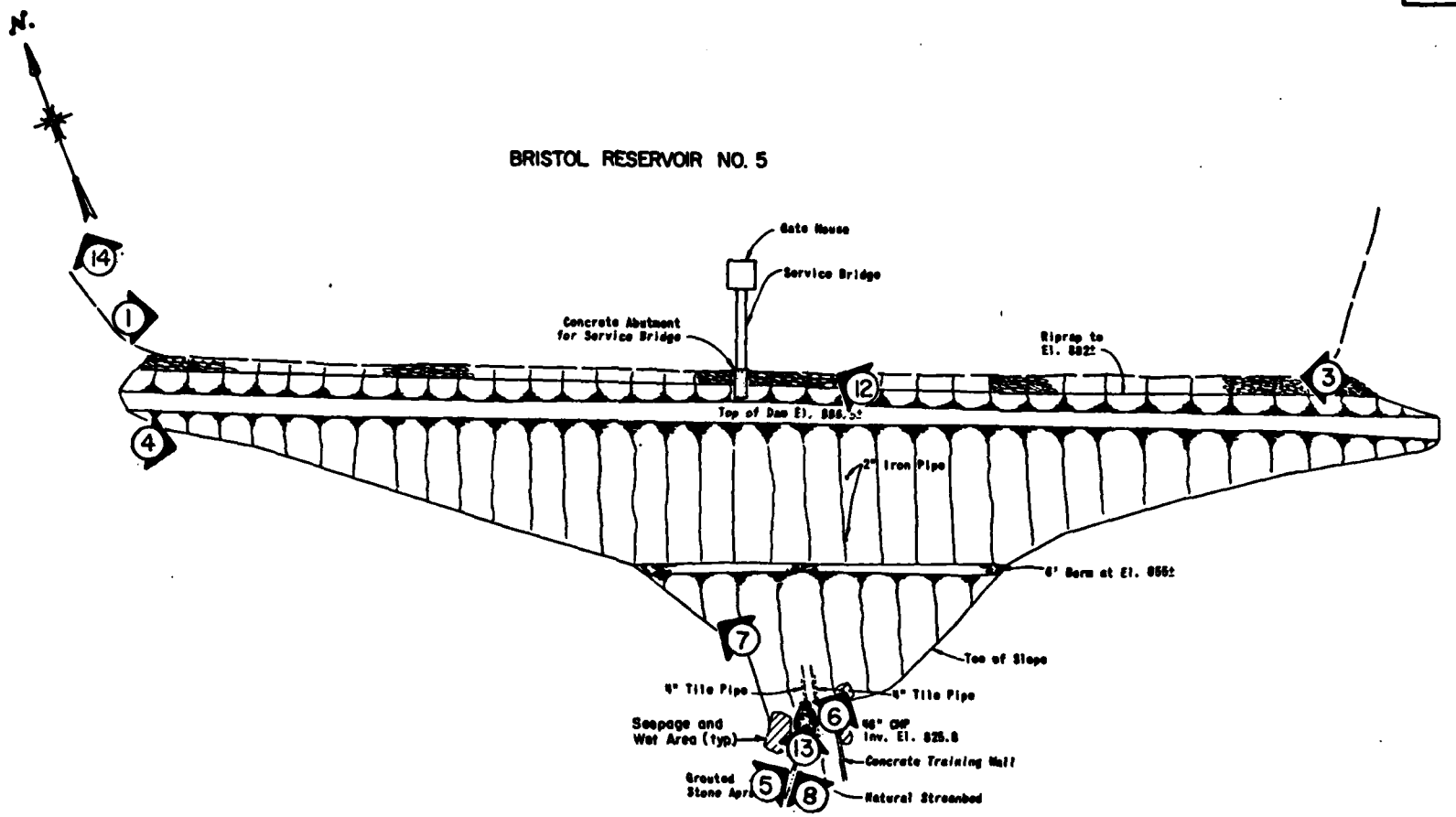
NOT TO SCALE

NOTE ELEVATIONS SHOWN + 730 = NGVD

APPENDIX C

PHOTOGRAPHS

FIGURE 3A



DENOTES PHOTO NUMBER AND DIRECTION IN WHICH PHOTO WAS TAKEN

ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

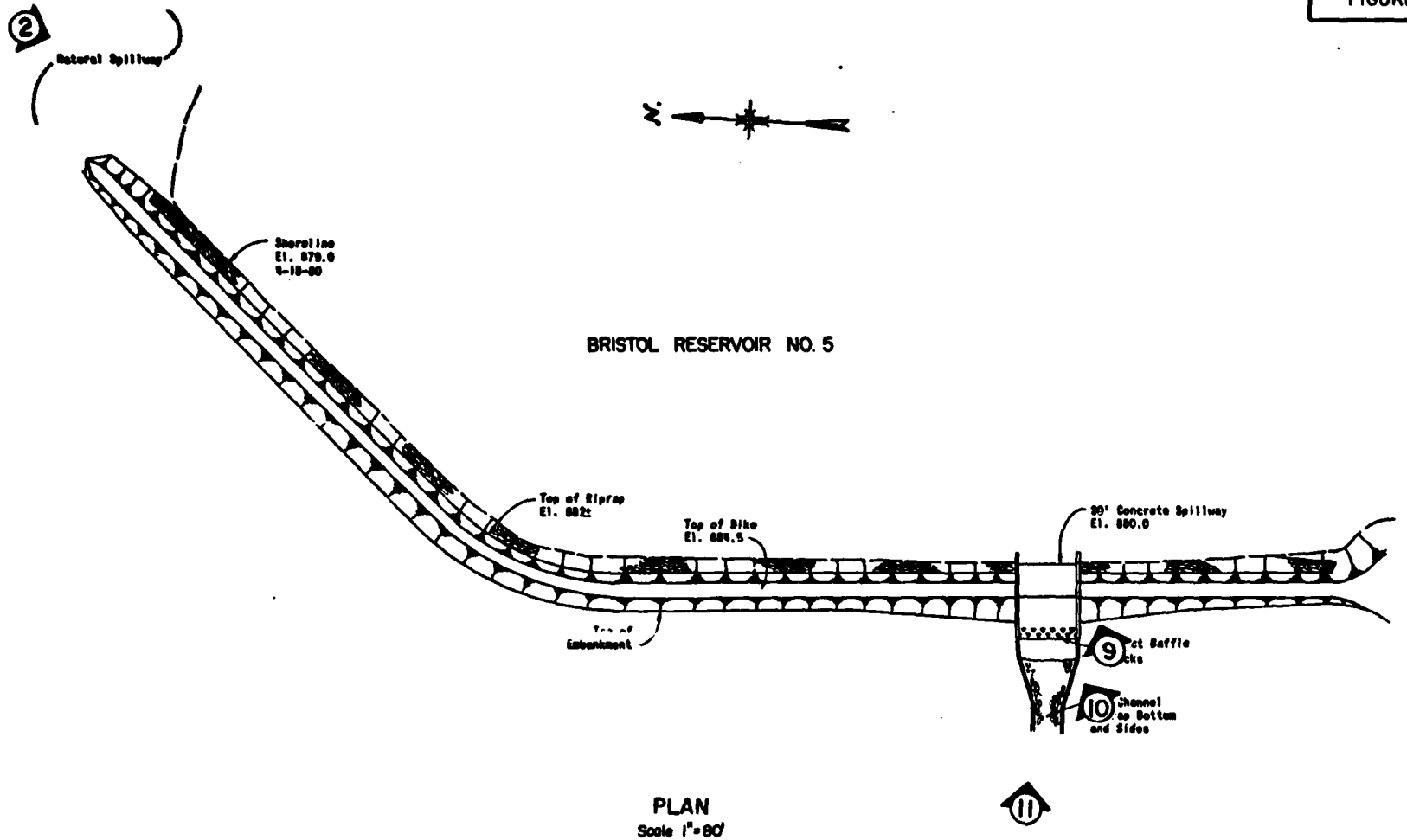
PHOTO LOCATION PLAN

BRISTOL RESERVOIR NO. 5
MAIN DAM

HARWINTON, CONNECTICUT

DRAWN	CHECKED	APPROVED	SCALES 1"=80'
JRS	RGL	RH	DATE JULY 1980 PAGE C-1

FIGURE 3B



PLAN
Scale 1"=80'

DENOTES PHOTO NUMBER
AND DIRECTION IN WHICH
PHOTO WAS TAKEN

ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PHOTO LOCATION PLAN

BRISTOL RESERVOIR NO. 5
DIKE AND SPILLWAY
HARWINTON, CONNECTICUT

DRAWN	CHECKED	APPROVED	SCALES 1"=80'
JRS	RGL	RH	DATE JULY 1980 PAGE C-2

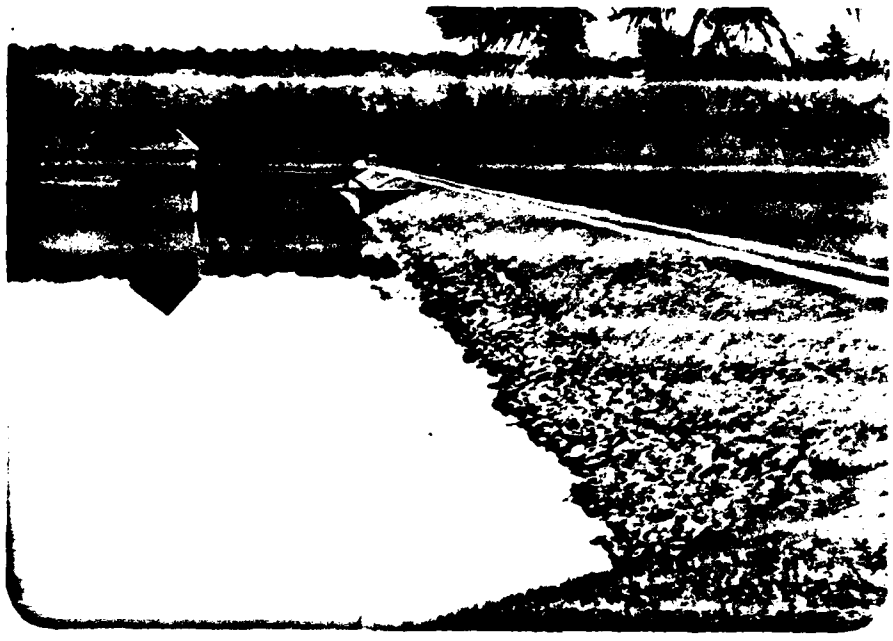


PHOTO NO. 1

MAIN DAM FROM RIGHT ABUTMENT

PHOTO NO. 2

OVERVIEW OF DIKE

U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 5 DAM TR. TO POLAND RIVER HARWINTON, CONNECTICUT CT 00366 6 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 3

DISPLACED RIPRAP SLOPE PAVING
NEAR LEFT END OF DAM

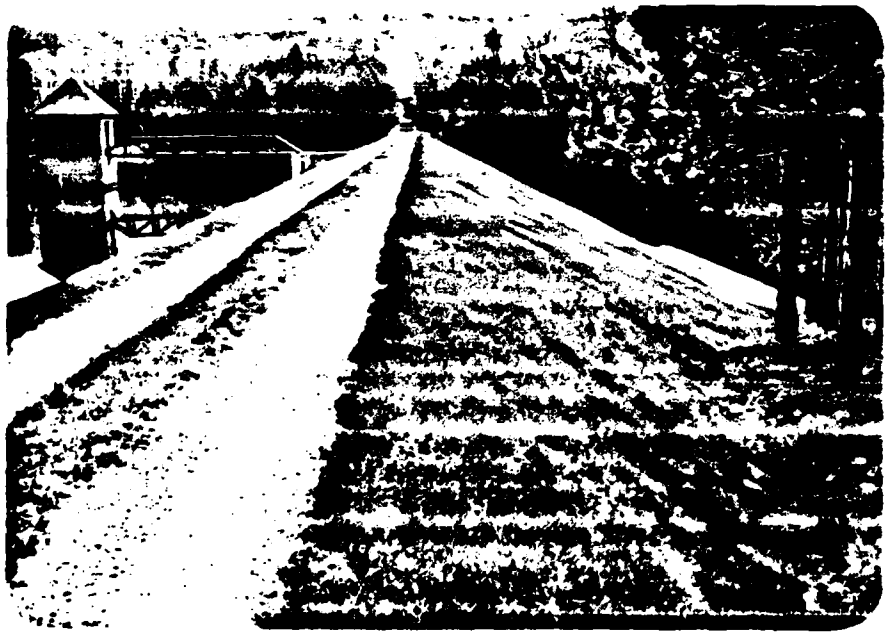


PHOTO NO. 4

CREST AND DOWNSTREAM SLOPE
OF DAM

U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 5 DAM TR. TO POLAND RIVER HARWINTON, CONNECTICUT CT 00366 6 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

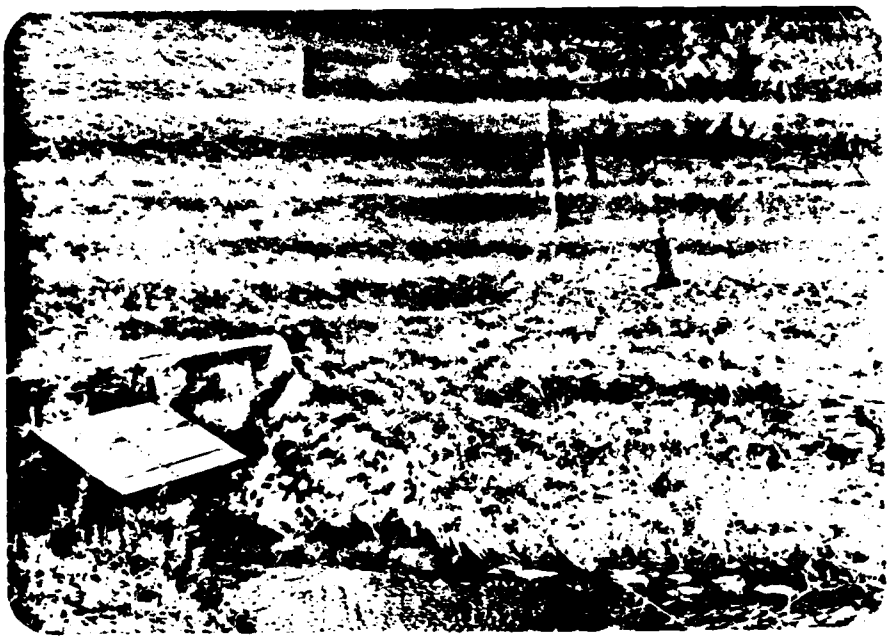


PHOTO NO. 5

AREA TO LEFT OF OUTLET WORKS DISCHARGE CHANNEL. NOTE DETERIORATED TRAINING WALL AT RIGHT AND EXTENDED RULE IN CENTER AT SEEPAGE AREA (PHOTO 6).

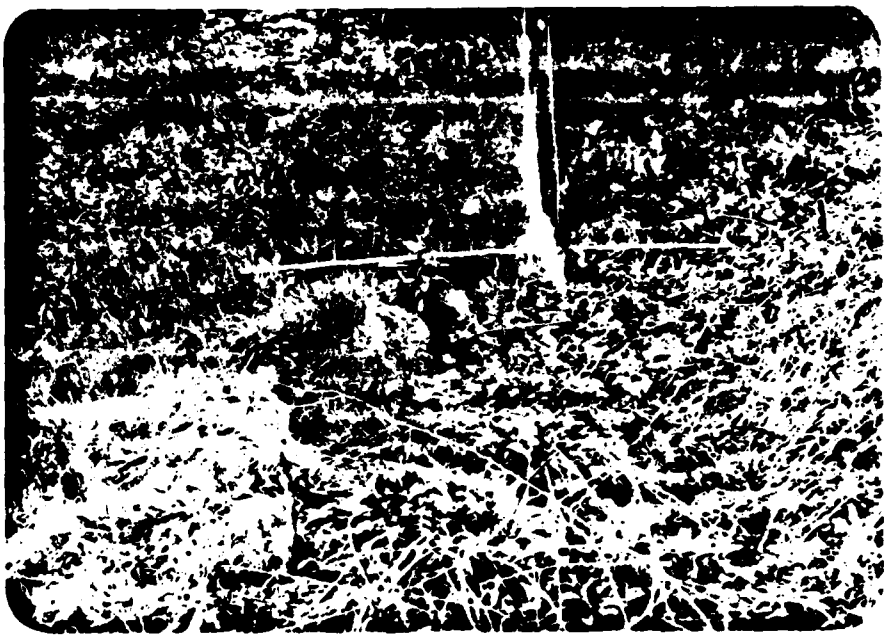


PHOTO NO. 6

SEEPAGE AT TOE OF SLOPE ADJACENT TO DOWNSTREAM TRAINING WALL.

U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 5 DAM TR. TO POLAND RIVER HARWINTON, CONNECTICUT CT 00366 6 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 7

EROSION GULLY AT CONTACT WITH RIGHT ABUTMENT

PHOTO NO. 8

WET AREA TO RIGHT OF OUTLET WORKS HEADWALL. NOTE MOISTURE LOVING VEGETATION AND VERTICAL ROCK ESCARPMENT.

U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 5 DAM TR. TO POLAND RIVER HARWINTON, CONNECTICUT CT 00366 6 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 9

EROSION ADJACENT TO LEFT
SPILLWAY TRAINING WALL.

U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 5 DAM TR. TO POLAND RIVER HARWINTON, CONNECTICUT CT 00366 6 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 10*

SPILLWAY. NOTE SEEPAGE NEAR RIGHT END
AND CONCRETE APRON DOWNSTREAM OF IMPACT BAFFLE BLOCKS.

PHOTO NO. 11

SPILLWAY DISCHARGE CHANNEL.
NOTE HAND PLACED RIPRAP PAVING IN FOREGROUND
AND CRUSHED STONE IN BACKGROUND.

*5 APRIL '80

U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 5 DAM TR. TO POLAND RIVER HARWINTON, CONNECTICUT CT 00366 6 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

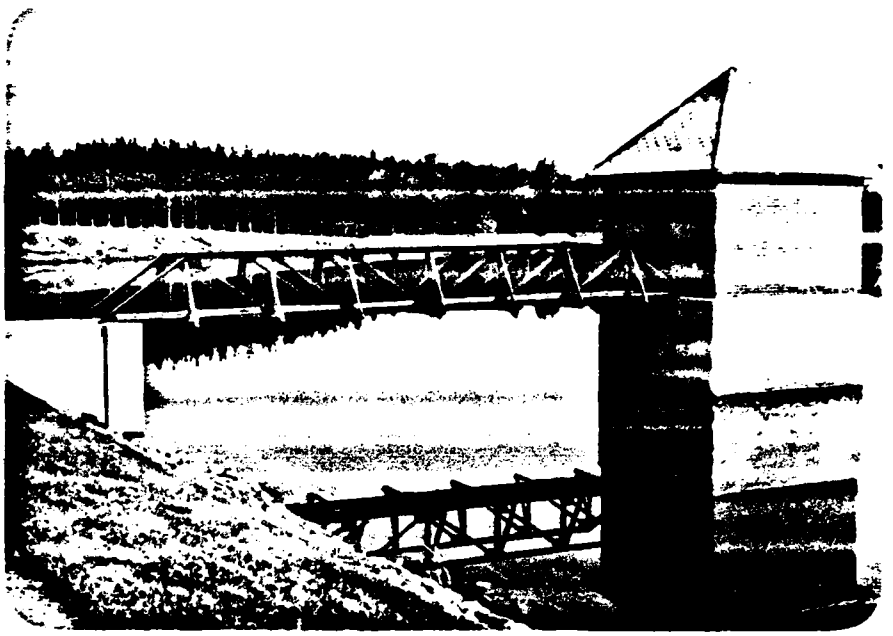


PHOTO NO. 12

GATEHOUSE AND SERVICE BRIDGE.
NOTE DETERIORATED CONCRETE NEAR WATER LINE.

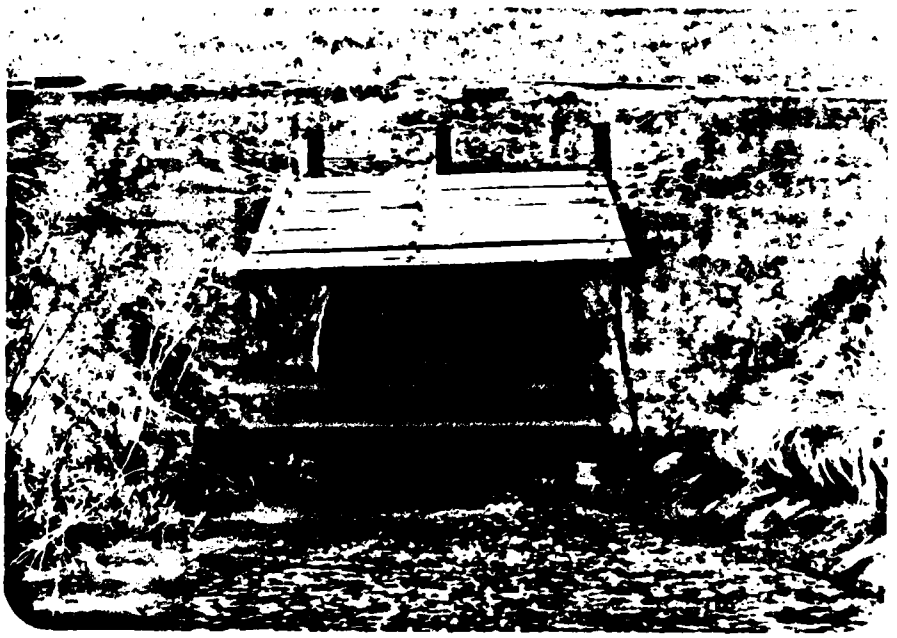


PHOTO NO. 13

OUTLET WORKS HEADWALL.
NOTE DETERIORATED CONCRETE AT TOP
AND 4-INCH DRAINS AT BASE.

U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 5 DAM TR. TO POLAND RIVER HARWINTON, CONNECTICUT CT 00366 6 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 14

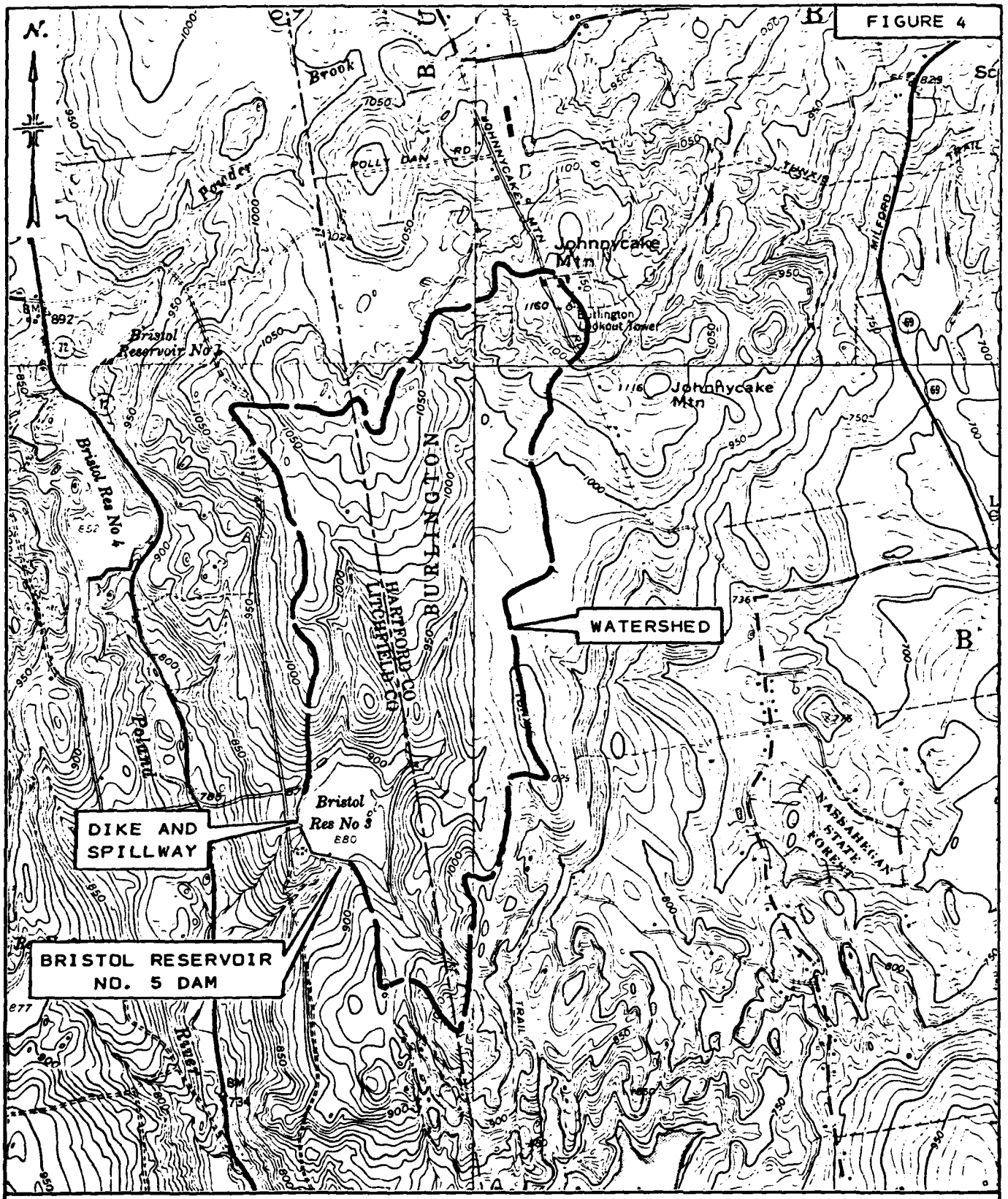
EROSION OF RESERVOIR BANK
UPSTREAM OF RIGHT ABUTMENT,
DIKE AND SPILLWAY IN BACKGROUND.

U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 5 DAM TR. TO POLAND RIVER HARWINTON, CONNECTICUT CT 00366 6 MAY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

FIGURE 4



WATERSHED MAP

BRISTOL RESERVOIR NO. 5 DAM
HARWINTON, CONNECTICUT

SCALE: 1" = 2000'

ROALD HAESTAD, INC. THOMASTON QUADRANGLE 1972

BY SAL DATE 5/14/80 **ROALD HAESTAD, INC.** SHEET NO 1 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 5/14/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO. 5 - Discharge Capacity

Spillway Data:

1) Length = 30 ft
2) Elevation = 880
3) Spillway is a concrete ogee section
4) Coefficient of discharge = 3.3

Dike Data:

1) Length = 730 ft
2) Elevation = 884.5
3) Coefficient of discharge = 2.8

Natural Spillway at end of dike:

1) Length = 120 ft
2) Elevation = 884
3) Coefficient of discharge = 2.5

Main Dam:

1) Length = 640 ft
2) Elevation = 886.5
3) Coefficient of discharge = 2.8

10" Outlet Pipe:

1) Length = 3 ft
2) Elevation = 870 (Invert)
3) Entrance loss = 1.00 $V_2^2/2g$

12" Outlet Pipe:

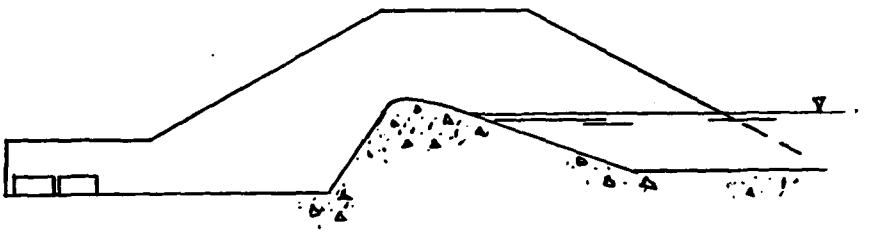
1) Length = 3 ft
2) Elevation = 859.5 (Invert)
3) Entrance loss = 1.00 $V_2^2/2g$

24" RCP Outlet Pipe:

1) Length = 75.5 ft
2) Elevation = 830.8 (Invert)
3) Entrance loss = 0.60 $V_2^2/2g$
4) Friction loss = $f(L/D)(V^2/2g)$

Spillway:

Length = 30'
Elev. = 880
Coeff = 3.3



Spillway Section

Main Spillway Capacity = $CLH^{3/2}$
(To top of dike)

$= 3.3(30)(4.5)^{3/2}$

$= 945$ cfs

Natural Spillway Capacity: (To top of dike)

C = 2.5
L = 120'
Elev = 884

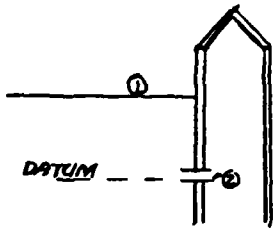
$Q = CLH^{3/2}$
$Q = 2.5(120)(0.5)^{3/2}$
$Q = 106$ cfs

Total Spillway Capacity = Main Spillway + Natural Spillway

$= 945$ cfs + 106 cfs

$= 1,051$ cfs

10" Outlet:



Use Bernoulli Equation

$$z_1 + P_1^{\,0} + V_1^{\,2}/2g^{\,0} = z_2^{\,0} + P_2^{\,0} + V_2^2/2g + H_L$$

$$z_1 = V_2^2/2g + 1\,V_2^2/2g$$

$$z_1 = 2\,V_2^2/2g = V_2^2/g$$

$$V_2 = \sqrt{z_1 g} \quad \& \quad Q = V_2 A$$

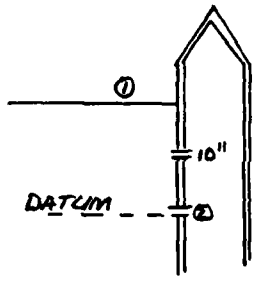
Elevation	z_1	V_2	Q
880	10	17.9	10
881	11	18.8	10
882	12	19.7	11
883	13	20.5	11
884	14	21.2	12
884.5	14.5	21.6	12
885.5	15.5	22.3	12
886.5	16.5	23.0	13

12" Outlet:

Use Bernoulli Equation

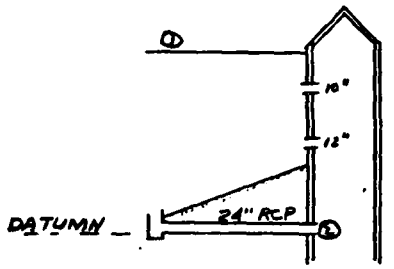
$$z_1 + P_1 + V_1^2/2g = z_2 + P_2 + V_2^2/2g + H_L$$

The Equation will reduce to $V_2 = \sqrt{z_1 g}$ & $Q = V_2 A$



Elevation	z_1	V_2	Q
880	20.5	25.7	20
881	21.5	26.3	21
882	22.5	26.9	21
883	23.5	27.5	22
884	24.5	28.1	22
884.5	25	28.4	22
885.5	26	28.9	23
886.5	27	29.5	23

24" RCP Outlet:



Use Bernoulli Equation:

$$z_1 + \cancel{p_1}^{0} + \cancel{V_1^2/2g}^{0} = \cancel{z_2}^{0} + \cancel{h_2}^{0} + V_2^2/2g + H_L$$

$$z_1 = V_2^2/2g + h_{ent.} + h_{friction}$$

$$z_1 = (1 + 0.5 + f(\tfrac{15.5}{2}))\, V_2^2/2g$$

Use a trial & error solution to determine the discharge.

Elev. 880:
$z_1 = 49.2'$ V_2 (assumed) = 20 ft/sec $\rightarrow f = 0.035 \rightarrow V_2 = 33.5$ ft/sec
V_2 (assumed) = 33.5 ft/sec $\rightarrow f = 0.0342 \rightarrow V_2 = 33.7$ ft/sec

$\therefore Q = V_2 \times A = 33.7 \text{ ft/sec} \times (3.14 \text{ ft}^2) = 106$ cfs

Elev 881:
$z_1 = 50.2'$ V_2 (assumed) = 34 ft/sec $\rightarrow f = 0.0341 \rightarrow V_2 = 34$ ft/sec

$\therefore Q = V_2 \times A = 34 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 107$ cfs

Elev 882:
$z_1 = 51.2'$ V_2 (assumed) = 34.5 ft/sec $\rightarrow f = 0.0341 \rightarrow V_2 = 34.4$ ft/sec

$\therefore Q = V_2 \times A = 34.4 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 108$ cfs

Elev 883:
$z_1 = 52.2'$ V_2 (assumed) = 35 ft/sec $\rightarrow f = 0.034 \rightarrow V_2 = 34.8$ ft/sec

$\therefore Q = V_2 \times A = 34.8 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 109$ cfs

Elev 884:
$z_1 = 53.2'$ V_2 (assumed) = 35 ft/sec $\rightarrow f = 0.034 \rightarrow V_2 = 35$ ft/sec

$\therefore Q = V_2 \times A = 35 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 110$ cfs

Elev 884.5:
$z_1 = 53.7'$ V_2 (assumed) = 35 ft/sec $\rightarrow f = 0.034 \rightarrow V_2 = 35.2$ ft/sec

$\therefore Q = V_2 \times A = 35.2 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 111$ cfs

24" RCP Outlet Continued:

Elev. 885.5
$Z_1 = 54.7'$ V_2 (assumed) $= 35.5$ ft/sec $\rightarrow f = 0.0339 \rightarrow V_2 = 35.6$ ft/sec

$\therefore Q = V_2 \times A = 35.6 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 112$ cfs

Elev. 886.5
$Z_1 = 55.7$ V_2 (assumed) $= 36$ ft/sec $\rightarrow f = 0.0339 \rightarrow V_2 = 35.9$ ft/sec

$\therefore Q = V_2 \times A = 35.9 \text{ ft/sec} \times 3.14 \text{ ft}^2 = 113$ cfs

10" Outlet, 12" Outlet, and 24" Outlet combined discharge.

Elevation (Feet)	10" Outlet (cfs)	12" Outlet (cfs)	24" Outlet (cfs)	Total Discharge (cfs)
880	10	20	106	136
881	10	21	107	138
882	11	21	108	140
883	11	22	109	142
884	12	22	110	144
884.5	12	22	111	145
885.5	12	23	112	147
886.5	13	23	113	149

Spillway, Dike, and Natural Spillway Discharge (Emergency Spillway)

Elevation (Feet)	Spillway (cfs)	Dike (cfs)	Natural Spillway (cfs)	Total Discharge (cfs)
880	0	0	0	0
881	99	0	0	99
882	280	0	0	280
883	514	0	0	514
884	792	0	0	792
884.5	945	0	106	1,051
885.5	1,277	2,044	551	3,872
886.5	1,641	5,781	1,186	8,608

TOTAL PROJECT DISCHARGE

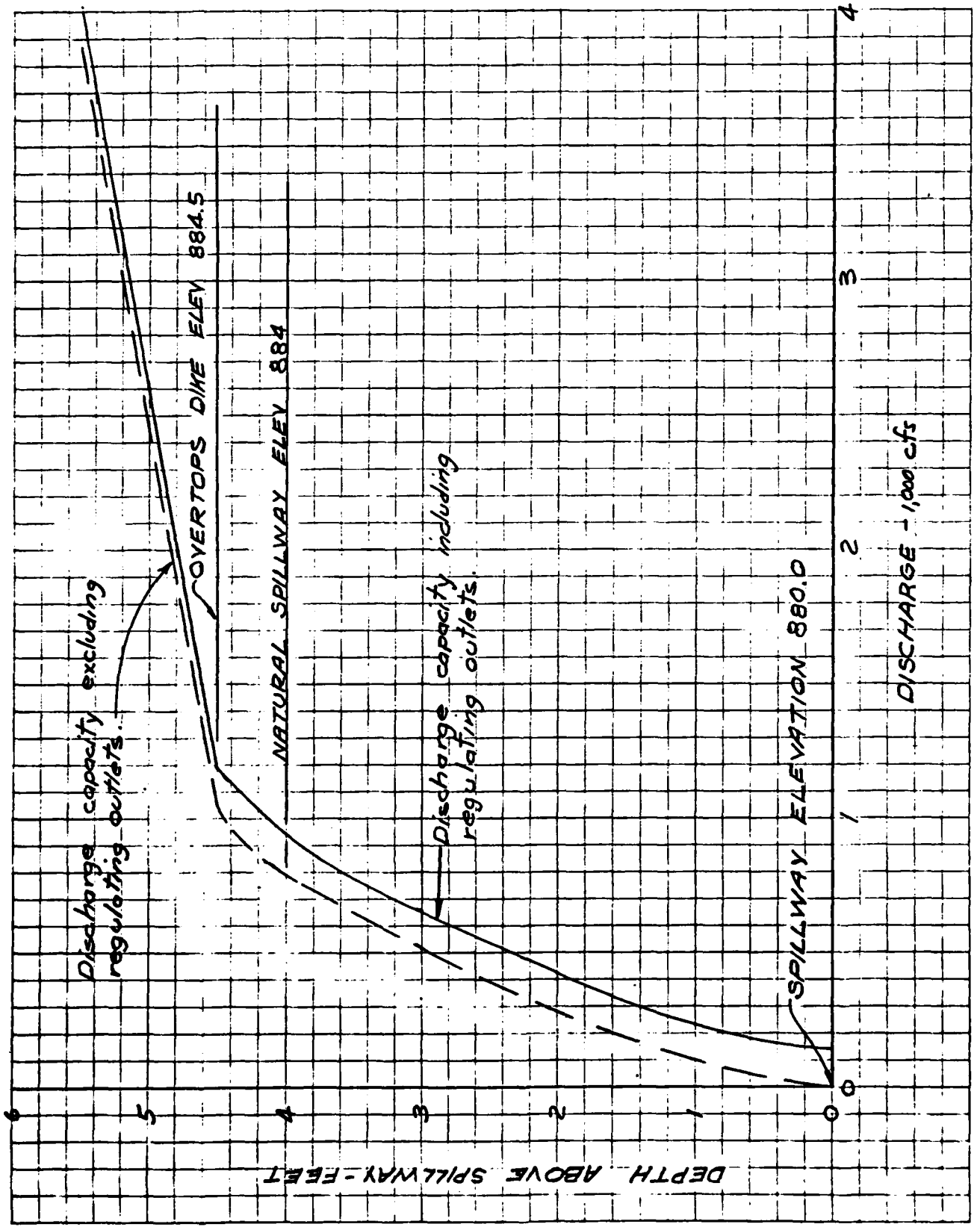
Elevation (Feet)	Spillway, Dike, and Natural Spillway (cfs)	10" Outlet, 12" Outlet, and 24" Outlet (cfs)	Project Discharge (cfs)
880	0	136	136
881	99	138	237
882	280	140	420
883	514	142	656
884	792	144	936
884.5	1,051	145	1,196
885.5	3,872	147	4,019
886.5	8,608	149	8,757

BY SAL DATE 5/2/80 **ROALD HAESTAD, INC.** SHEET NO 7 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 5/9/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO. 5 - Discharge Capacity Curve



BY SAL DATE 6/30/80 **ROALD HAESTAD, INC.** SHEET NO 8 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-023

SUBJECT BRISTOL RESERVOIR NO. 5 - Surcharge Storage Capacity

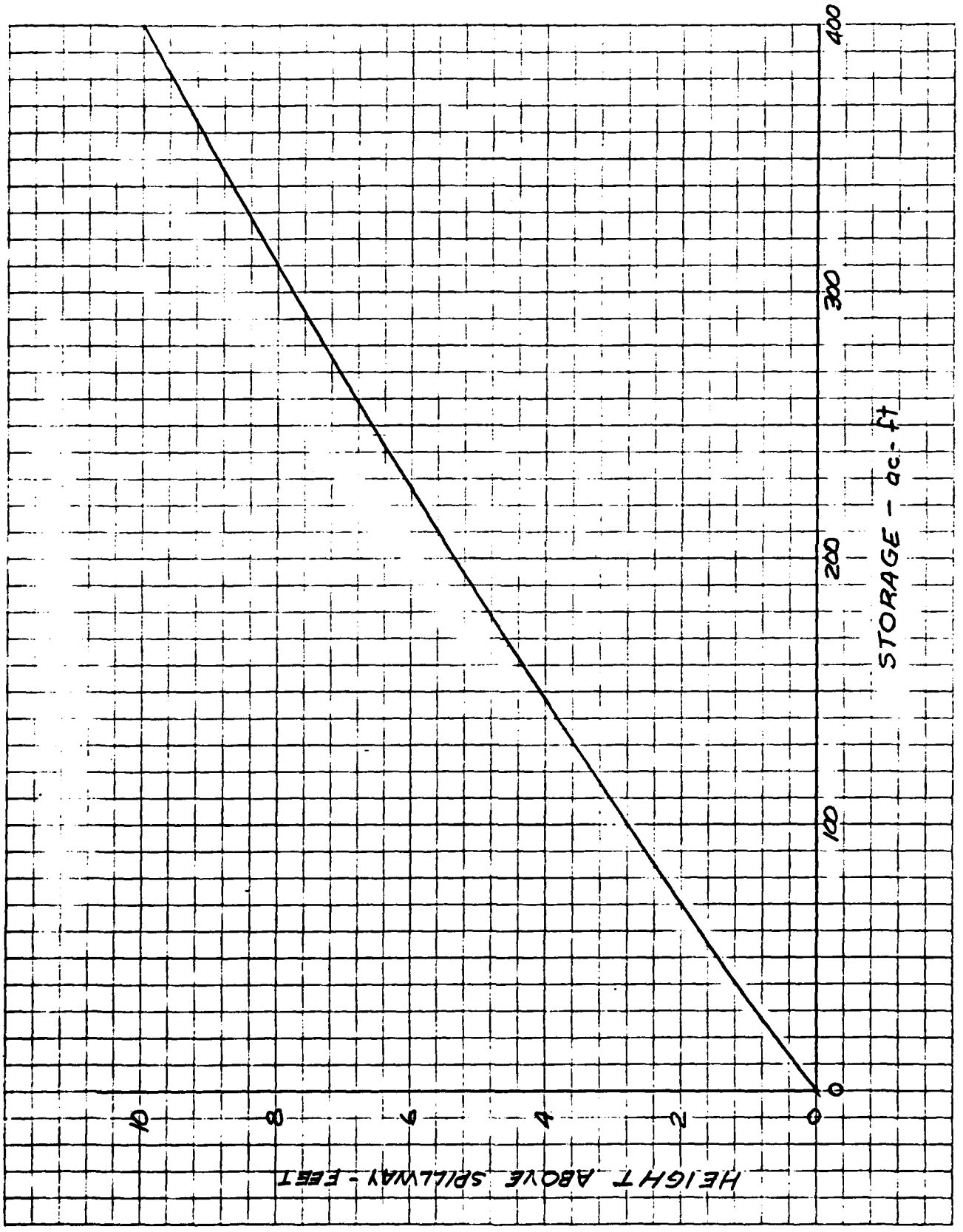
Elevation (feet)	Surface Area (Acres)	Average Surface Area (Acres)	Storage Capacity (Acre-ft)
880	34.0		0
		35.2	
882	36.4		70.4
		37.6	
884	38.8		145.6
		40.0	
886	41.2		225.6
		42.4	
888	43.6		310.4
		44.8	
890	46.0		400.0

BY SAL DATE 5/2/80 **ROALD HAESTAD, INC.** SHEET NO 9 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 5/7/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO. 5 - Surcharge Storage Capacity Curve



Test Flood = PMF

Drainage Area = 706 acres = 1.1 sq mile

From CORPS OF ENG Chart for "Rolling" Terrain

MPF = 2,125 cfs/sq. mi. (2.0 sq mi minimum)

PMF = 2,125 cfs/sq. mi. × 1.1 sq. mi. = 2,338 cfs

PMF = 2,338 cfs use 2,350 cfs

Q_{P1} = 2,350 cfs

H_1 = 5.0 ft above spillway, from Discharge Curve

$STOR_1$ = 186 ac-ft, from Storage Capacity Curve

= 3.2" runoff from 1.1 sq mi

MPF Runoff in New England equals approx 19"

$Q_{P2} = Q_{P1}(1 - STOR_1/19) = 2,350 cfs (1 - 3.2/19) = 1,954$ cfs

H_2 = 4.8 ft $STOR_2$ = 179 ac-ft

$STOR_{AVE} = (STOR_1 + STOR_2)/2 = 182.5$ ac-ft = 3.1" of runoff

$Q_{P3} = Q_{P1}(1 - STOR_{AVE}/19) = 2,350$ cfs $(1 - 3.1/19) = 1,967$ cfs
Use 1,970 cfs

H_3 = 4.83 use 4.8 ft

Spillway Capacity = Spillway + Emergency Spillway
(Top of dike) = $CLH^{3/2} + CLH^{3/2}$
= $3.3(30)(4.5)^{3/2} + 2.5(120)(0.5)^{2/2}$
= 1051 use 1,050 cfs

% PMF = $(1050/1,970) \times 100 = 53\%$ of PMF

S = Storage at time of failure = Storage at spillway level + Freeboard storage

$$S = \left[201.6 \times 10^6 \text{ gal} \times \frac{1 \text{ ac-ft}}{326,851 \text{ gal}}\right] + \left[247 \text{ ac-ft}\right] \quad \text{(Note: from storage Capacity Curve)}$$

$S = 618.7 \text{ ac-ft} + 247 \text{ ac-ft} = 865.7$ use 866 ac-ft

Q_{pl} = Peak Failure Outflow = $8/27\ W_b \sqrt{g}\ Y_o^{3/2}$

W_b = Breach Width = 40% of dam length across river at mid height = 0.4(205) = 82 ft

Y_o = Total height from river bed to pool level at time of failure = 60 ft

$Q_{pl} = 8/27\,(82)(\sqrt{32.2})(60)^{3/2} = 64,076$ use 64,100 cfs

SECTION NUMBER 1

TOTAL SECTION

H	W	A	R	S	V	Q
1.0	50	25	.50	.0077	.82	21
2.0	100	100	1.00	.0077	1.30	130
3.0	150	225	1.50	.0077	1.71	384
4.0	200	400	2.00	.0077	2.07	828
5.0	250	625	2.50	.0077	2.40	1500
6.0	300	900	3.00	.0077	2.71	2440
7.0	350	1225	3.50	.0077	3.00	3680
8.0	400	1600	4.00	.0077	3.28	5254
9.0	450	2025	4.50	.0077	3.55	7193
10.0	500	2500	5.00	.0077	3.81	9527
11.0	518	3009	5.81	.0077	4.21	12676
12.0	536	3535	6.60	.0077	4.59	16217
13.0	553	4079	7.37	.0077	4.94	20145
14.0	571	4640	8.13	.0077	5.27	24456
15.0	589	5219	8.87	.0077	5.59	29152
16.0	606	5815	9.59	.0077	5.89	34231
17.0	624	6429	10.30	.0077	6.17	39696
18.0	642	7060	11.01	.0077	6.45	45548
19.0	659	7709	11.69	.0077	6.72	51790
20.0	677	8375	12.37	.0077	6.98	58425
21.0	689	9056	13.14	.0077	7.26	65741
22.0	702	9750	13.89	.0077	7.53	73451
23.0	715	10456	14.63	.0077	7.80	81553
24.0	727	11175	15.36	.0077	8.06	90048
25.0	740	11906	16.09	.0077	8.31	98936

MANNING COEFFICIENT=N=.1000
STORAGE AT TIME OF FAILURE=S= 866 AC. FT.
LENGHT OF REACH=L= 1000 FT.

INFLOW INTO REACH=QP1=64100 CFS
DEPTH OF FLOW=H1= 20.8 FT.
CROSS SECTIONAL AREA=A1= 8905 SQ. FT.
STORAGE IN REACH=V1=204.4 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)=48968 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 18.6 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 7418 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)=170.3 AC. FT.

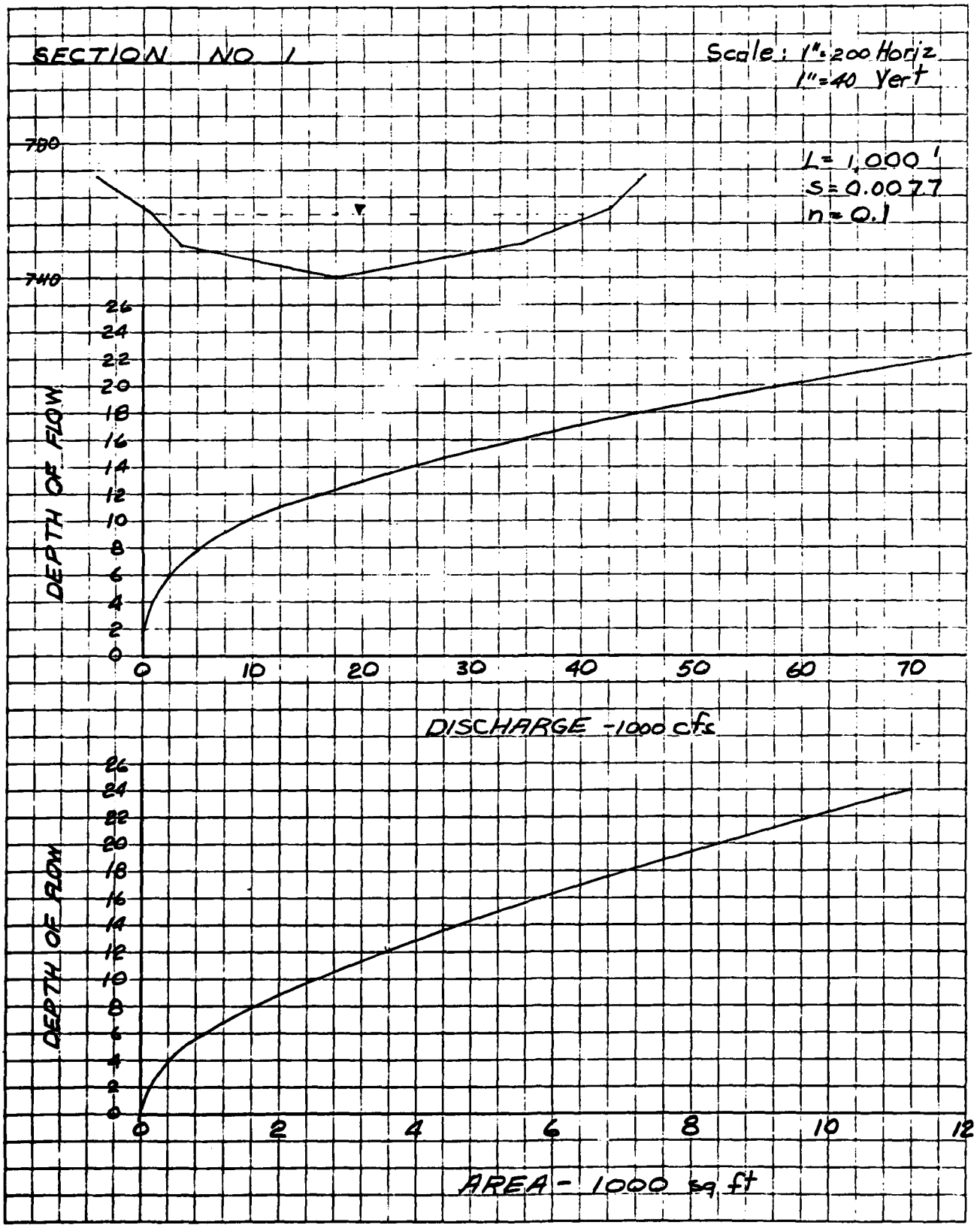
REACH OUTFLOW=QP2=50231 CFS
DEPTH OF FLOW=H2= 18.8 FT.

BY SAL DATE 4/30/80 **ROALD HAESTAD, INC.** SHEET NO 13 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO. 5 - Flood Routing



SUBJECT BRISTOL RESERVOIR NO. 5 - FLOOD ROUTING

SECTION NUMBER 2

TOTAL SECTION

H	W	A	R	S	V	Q
1.0	28	14	.50	.0067	.76	11
2.0	55	55	1.00	.0067	1.21	67
3.0	83	124	1.50	.0067	1.59	197
4.0	110	220	1.99	.0067	1.93	424
5.0	138	344	2.49	.0067	2.24	769
6.0	165	495	2.99	.0067	2.53	1250
7.0	193	674	3.49	.0067	2.80	1886
8.0	221	880	3.99	.0067	3.06	2692
9.0	248	1114	4.49	.0067	3.31	3686
10.0	276	1375	4.99	.0067	3.55	4882
11.0	296	1660	5.61	.0067	3.84	6376
12.0	316	1965	6.22	.0067	4.11	8083
13.0	336	2290	6.81	.0067	4.37	10012
14.0	356	2635	7.40	.0067	4.62	12169
15.0	376	3000	7.97	.0067	4.85	14563
16.0	396	3385	8.54	.0067	5.08	17202
17.0	416	3790	9.10	.0067	5.30	20094
18.0	437	4215	9.65	.0067	5.51	23246
19.0	457	4660	10.20	.0067	5.72	26666
20.0	477	5125	10.75	.0067	5.92	30362
21.0	494	5609	11.34	.0067	6.14	34442
22.0	512	6110	11.93	.0067	6.35	38806
23.0	530	6629	12.51	.0067	6.56	43459
24.0	547	7165	13.09	.0067	6.76	48407
25.0	565	7719	13.66	.0067	6.95	53655

MANNING COEFFICIENT=N=.1000
STORAGE AT TIME OF FAILURE=S= 866 AC. FT.
LENGHT OF REACH=L= 1500 FT.

INFLOW INTO REACH=QP1=50231 CFS
DEPTH OF FLOW=H1= 24.4 FT.
CROSS SECTIONAL AREA=A1= 7359 SQ. FT.
STORAGE IN REACH=V1=253.4 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)=35532 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 21.3 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 5735 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)=197.5 AC. FT.

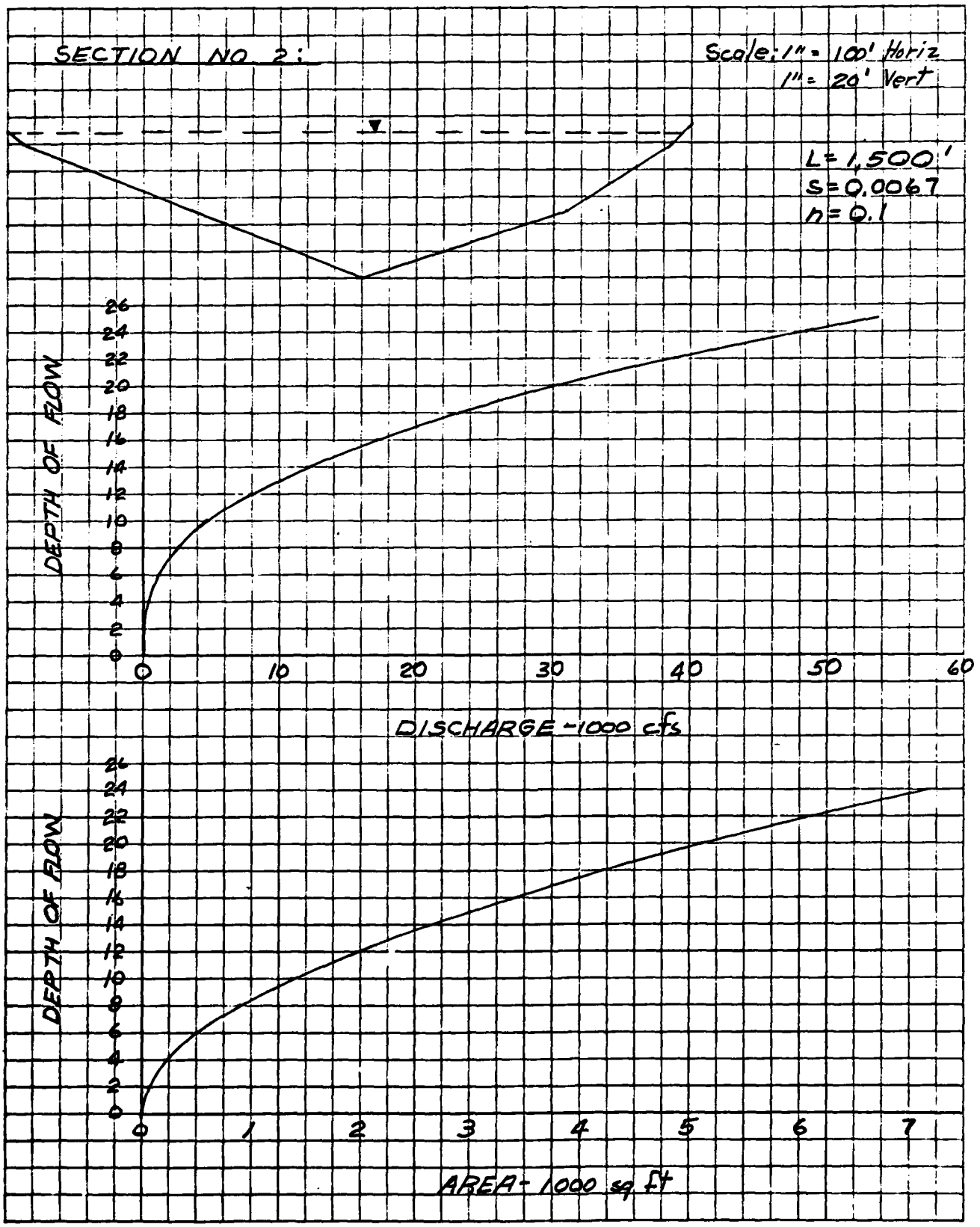
REACH OUTFLOW=QP2=37154 CFS
DEPTH OF FLOW=H2= 21.6 FT.

BY SAL DATE 4/28/80 **ROALD HAESTAD, INC.** SHEET NO 15 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO. 5 - Flood Routing



SECTION NUMBER 3

TOTAL SECTION

H	W	A	R	S	V	Q
1.0	23	11	.50	.0180	1.25	14
2.0	45	45	1.00	.0180	1.99	89
3.0	68	101	1.49	.0180	2.61	264
4.0	90	180	1.99	.0180	3.16	568
5.0	113	281	2.49	.0180	3.66	1030
6.0	136	405	2.99	.0180	4.14	1675
7.0	158	551	3.49	.0180	4.58	2527
8.0	181	720	3.98	.0180	5.01	3608
9.0	203	911	4.48	.0180	5.42	4939
10.0	226	1125	4.98	.0180	5.81	6541
11.0	246	1360	5.53	.0180	6.23	8477
12.0	266	1615	6.07	.0180	6.63	10713
13.0	286	1890	6.60	.0180	7.02	13263
14.0	306	2185	7.13	.0180	7.39	16143
15.0	326	2500	7.66	.0180	7.75	19367
16.0	346	2835	8.18	.0180	8.10	22950
17.0	367	3190	8.70	.0180	8.43	26906
18.0	387	3565	9.22	.0180	8.77	31249
19.0	407	3960	9.73	.0180	9.09	35994
20.0	427	4375	10.25	.0180	9.41	41153

MANNING COEFFICIENT=N=.1000
STORAGE AT TIME OF FAILURE=S= 866 AC. FT.
LENGHT OF REACH=L= 1800 FT.

INFLOW INTO REACH=QP1=37154 CFS
DEPTH OF FLOW=H1= 19.2 FT.
CROSS SECTIONAL AREA=A1= 4055 SQ. FT.
STORAGE IN REACH=V1=167.5 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)=29966 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 17.7 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 3456 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)=142.8 AC. FT.

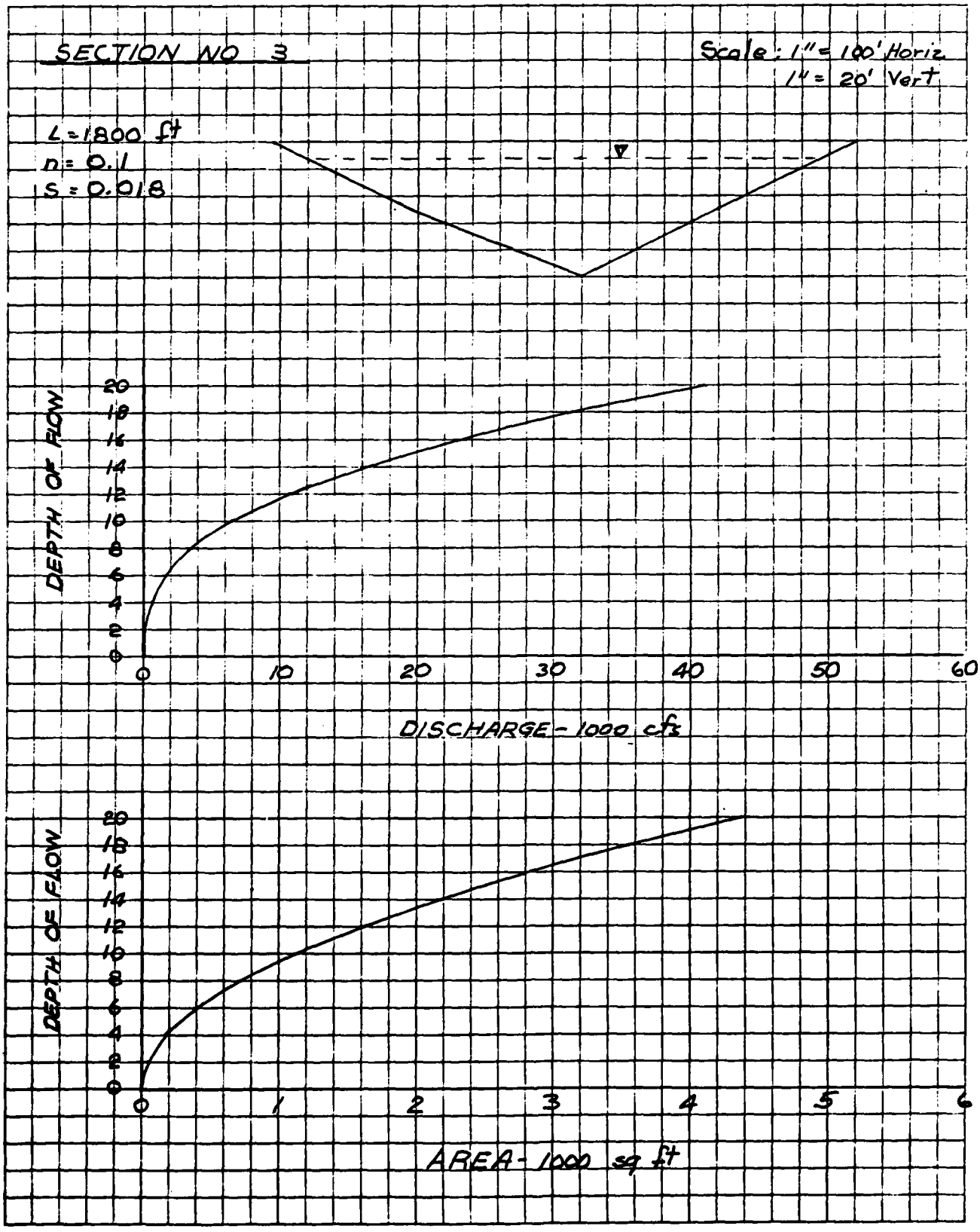
REACH OUTFLOW=QP2=30497 CFS
DEPTH OF FLOW=H2= 17.8 FT.

BY SAL DATE 4/28/80. **ROALD HAESTAD, INC.** SHEET NO 17 OF 37

CONSULTING ENGINEERS

CKD BY DLL DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO 5 - Flood Routing



BY SAL DATE 7/3/80 ROALD HAESTAD, INC. SHEET NO 18 OF 37

CKD BY DLS DATE 7/3/80 CONSULTING ENGINEERS JOB NO 49-023

SUBJECT BRISTOL RESERVOIR NO. 5 - FLOOD ROUTING

SECTION NUMBER 4

TOTAL SECTION

H	W	A	R	S	V	Q
1.0	92	46	.50	.0024	.46	21
2.0	183	183	1.00	.0024	.73	133
3.0	275	412	1.50	.0024	.95	393
4.0	343	721	2.11	.0024	1.20	862
5.0	410	1097	2.68	.0024	1.40	1540
6.0	478	1541	3.23	.0024	1.59	2450
7.0	545	2052	3.76	.0024	1.76	3616
8.0	613	2631	4.29	.0024	1.92	5060
9.0	680	3277	4.82	.0024	2.08	6806
10.0	748	3991	5.34	.0024	2.22	8873
11.0	815	4772	5.85	.0024	2.36	11284
12.0	883	5621	6.37	.0024	2.50	14057
13.0	951	6537	6.88	.0024	2.63	17212
14.0	1033	7529	7.29	.0024	2.74	20602
15.0	1116	8602	7.71	.0024	2.84	24443
16.0	1198	9759	8.14	.0024	2.95	28759
17.0	1281	10997	8.59	.0024	3.05	33572
18.0	1363	12319	9.04	.0024	3.16	38906
19.0	1446	13722	9.49	.0024	3.26	44783
20.0	1528	15209	9.95	.0024	3.37	51223
21.0	1611	16777	10.42	.0024	3.47	58250
22.0	1693	18429	10.88	.0024	3.58	65883
23.0	1776	20162	11.35	.0024	3.68	74143

MANNING COEFFICIENT=N=.1000
STORAGE AT TIME OF FAILURE=S= 866 AC. FT.
LENGHT OF REACH=L= 1600 FT.

INFLOW INTO REACH=QP1=30497 CFS
DEPTH OF FLOW=H1= 16.4 FT.
CROSS SECTIONAL AREA=A1=10212 SQ. FT.
STORAGE IN REACH=V1=375.1 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)=17288 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 13.0 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 6560 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)=241.0 AC. FT.

REACH OUTFLOW=QP2=19650 CFS
DEPTH OF FLOW=H2= 13.7 FT.

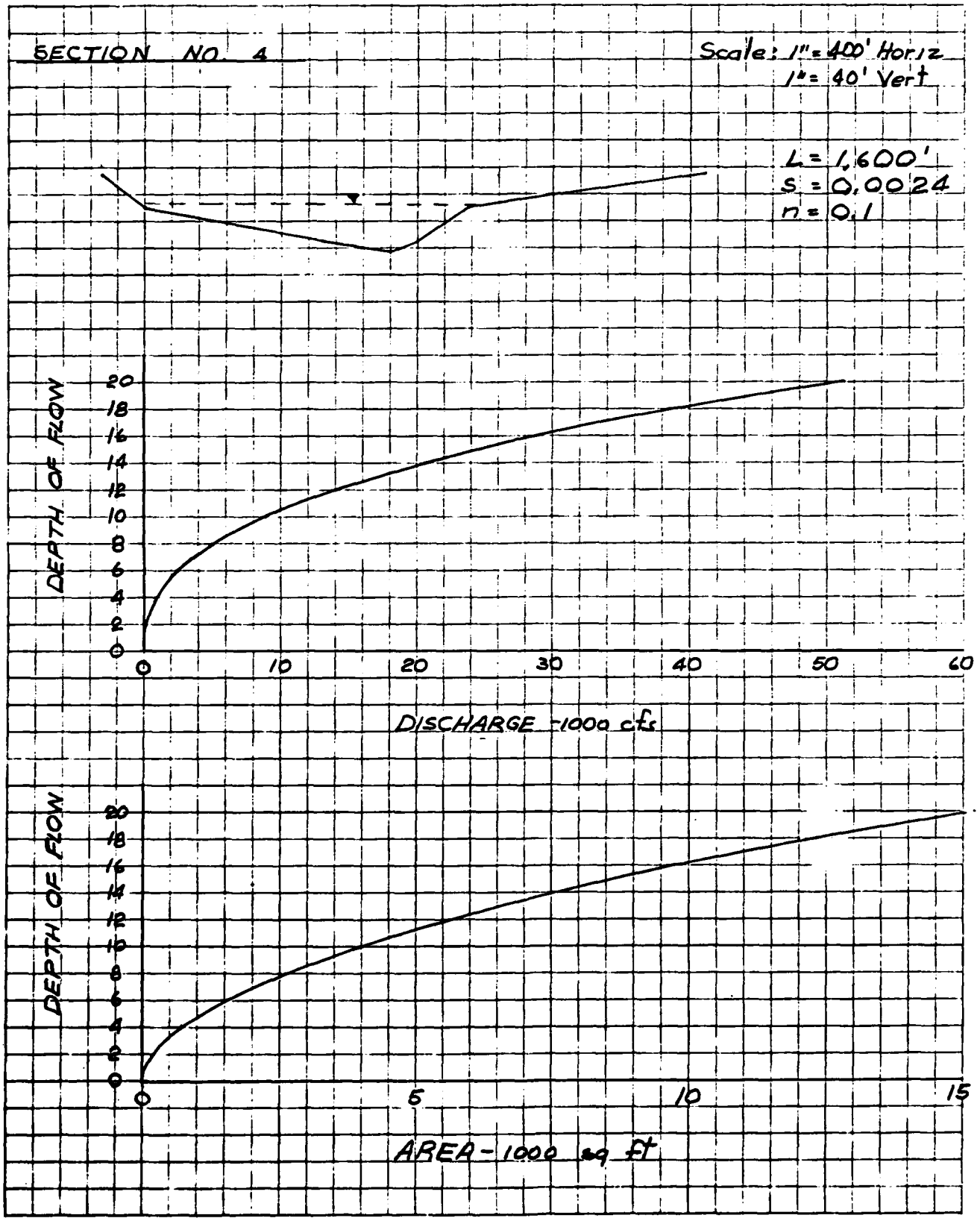
REACH OUTFLOW=QP2=20381 CFS
DEPTH OF FLOW=H2= 13.9 FT.

BY SAL DATE 4/30/80 **ROALD HAESTAD, INC.** SHEET NO 19 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO. 5 - Flood Routing



SUBJECT BRISTOL RESERVOIR NO. 5 - FLOOD ROUTING

SECTION NUMBER 5

TOTAL SECTION

H	W	A	R	S	V	Q
1.0	40	20	.50	.0024	.46	9
2.0	80	80	1.00	.0024	.73	58
3.0	119	179	1.50	.0024	.95	171
4.0	159	318	2.00	.0024	1.15	367
5.0	199	497	2.50	.0024	1.34	666
6.0	239	716	3.00	.0024	1.51	1083
7.0	279	974	3.50	.0024	1.68	1634
8.0	319	1272	3.99	.0024	1.83	2332
9.0	405	1632	4.03	.0024	1.84	3010
10.0	440	2053	4.67	.0024	2.03	4176
11.0	475	2510	5.29	.0024	2.21	5545
12.0	510	3002	5.88	.0024	2.37	7124
13.0	545	3529	6.47	.0024	2.53	8922
14.0	581	4091	7.05	.0024	2.68	10948
15.0	616	4689	7.61	.0024	2.82	13211
16.0	651	5321	8.17	.0024	2.95	15720
17.0	686	5989	8.73	.0024	3.09	18482
18.0	721	6692	9.28	.0024	3.21	21507

MANNING COEFFICIENT=N=.1000
STORAGE AT TIME OF FAILURE=S= 866 AC. FT.
LENGHT OF REACH=L= 2400 FT.

INFLOW INTO REACH=QP1=20381 CFS
DEPTH OF FLOW=H1= 17.6 FT.
CROSS SECTIONAL AREA=A1= 6433 SQ. FT.
STORAGE IN REACH=V1=354.4 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)=12039 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 14.5 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 4383 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)=241.5 AC. FT.

REACH OUTFLOW=QP2=13368 CFS
DEPTH OF FLOW=H2= 15.1 FT.

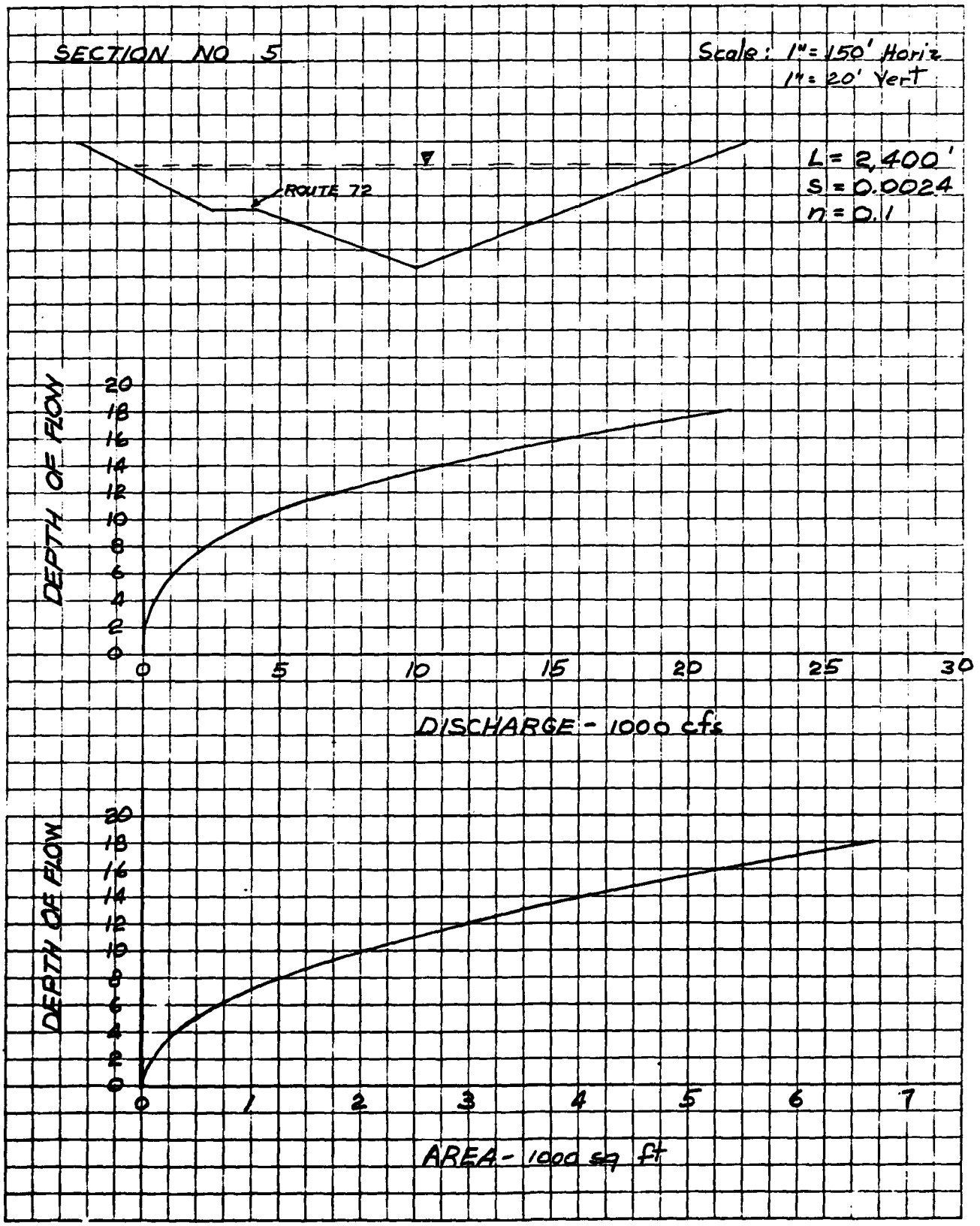
REACH OUTFLOW=QP2=13809 CFS
DEPTH OF FLOW=H2= 15.2 FT.

BY SAL DATE 4/28/80 **ROALD HAESTAD, INC.** SHEET NO 21 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO 5 - Flood Routing



SECTION NUMBER 6

TOTAL SECTION

H	W	A	R	S	V	Q
1.0	30	15	.50	.0100	.93	14
2.0	60	60	1.00	.0100	1.48	89
3.0	90	135	1.50	.0100	1.94	262
4.0	120	240	1.99	.0100	2.35	565
5.0	150	375	2.49	.0100	2.73	1024
6.0	181	540	2.99	.0100	3.08	1666
7.0	211	735	3.49	.0100	3.42	2513
8.0	241	960	3.99	.0100	3.74	3588
9.0	271	1215	4.49	.0100	4.04	4912
10.0	301	1500	4.99	.0100	4.34	6505
11.0	346	1823	5.27	.0100	4.50	8199
12.0	391	2190	5.60	.0100	4.69	10263
13.0	436	2603	5.97	.0100	4.89	12723
14.0	481	3060	6.36	.0100	5.10	15608
15.0	526	3563	6.77	.0100	5.32	18944
16.0	571	4110	7.19	.0100	5.54	22759

MANNING COEFFICIENT=N=.1000
STORAGE AT TIME OF FAILURE=S= 866 AC. FT.
LENGHT OF REACH=L= 2000 FT.

INFLOW INTO REACH=QP1=13809 CFS
DEPTH OF FLOW=H1= 13.4 FT.
CROSS SECTIONAL AREA=A1= 2778 SQ. FT.
STORAGE IN REACH=V1=127.5 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)=11775 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 12.6 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 2446 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)=112.3 AC. FT.

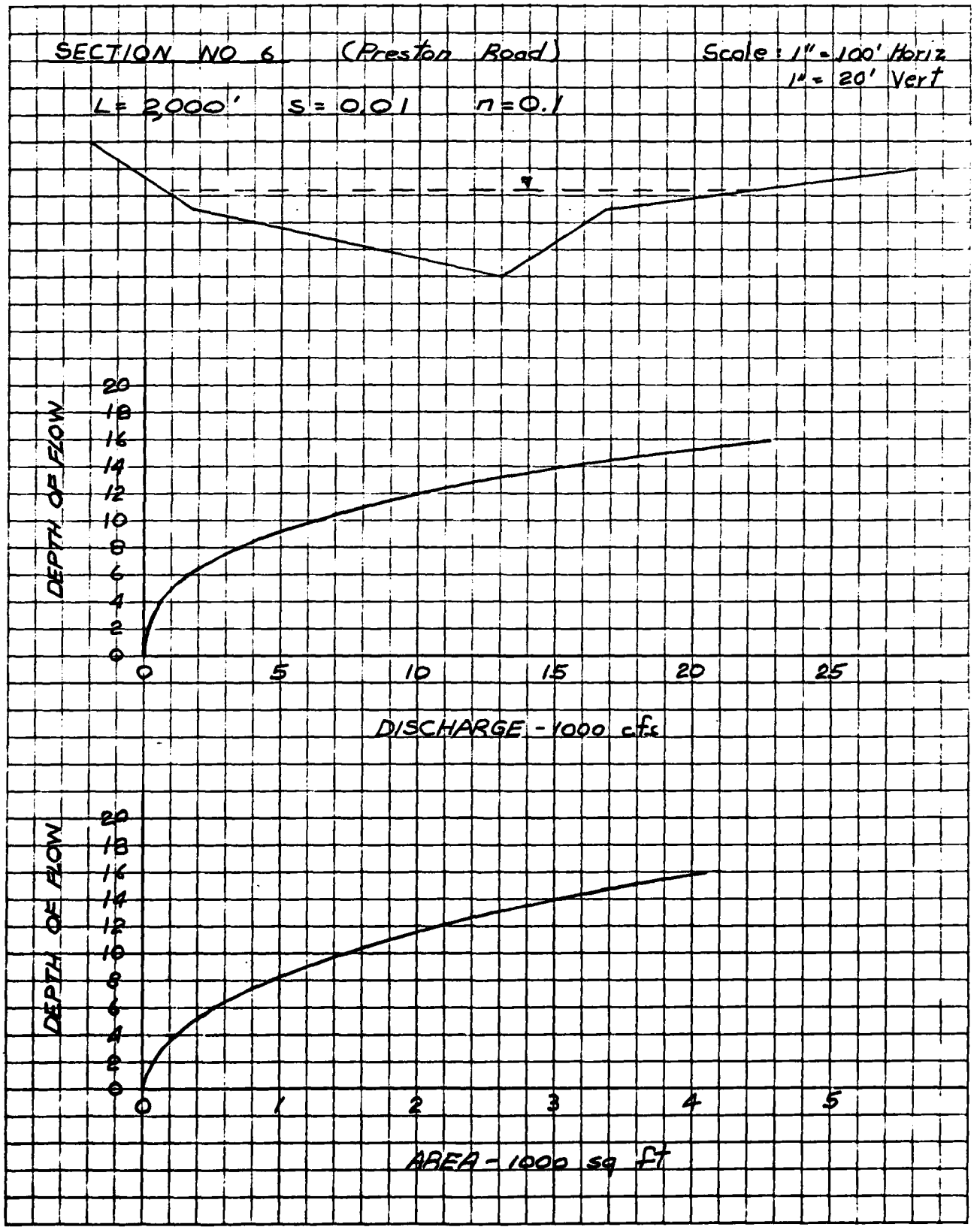
REACH OUTFLOW=QP2=11897 CFS
DEPTH OF FLOW=H2= 12.7 FT.

BY SAL DATE 4/28/80 **ROALD HAESTAD, INC.** SHEET NO 23 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO 5 - Flood Routing



SECTION NUMBER 7

TOTAL SECTION

H	W	A	R	S	V	Q
1.0	28	14	.50	.0087	1.24	17
2.0	55	55	1.00	.0087	1.98	109
3.0	83	124	1.50	.0087	2.59	320
4.0	110	220	1.99	.0087	3.14	690
5.0	138	344	2.49	.0087	3.64	1251
6.0	165	495	2.99	.0087	4.11	2035
7.0	193	674	3.49	.0087	4.56	3069
8.0	221	880	3.99	.0087	4.98	4382
9.0	248	1114	4.49	.0087	5.39	6000
10.0	276	1375	4.99	.0087	5.78	7946
11.0	289	1656	5.74	.0087	6.35	10514
12.0	301	1950	6.47	.0087	6.88	13410
13.0	314	2256	7.19	.0087	7.37	16635
14.0	327	2575	7.88	.0087	7.84	20191
15.0	339	2906	8.56	.0087	8.29	24081
16.0	352	3250	9.23	.0087	8.71	28309
17.0	365	3606	9.88	.0087	9.12	32880
18.0	378	3975	10.52	.0087	9.51	37797
19.0	390	4356	11.16	.0087	9.89	43067
20.0	403	4750	11.78	.0087	10.25	48695

MANNING COEFFICIENT=N=.0700
STORAGE AT TIME OF FAILURE=S= 866 AC. FT.
LENGHT OF REACH=L= 3000 FT.

INFLOW INTO REACH=QP1=11897 CFS
DEPTH OF FLOW=H1= 11.5 FT.
CROSS SECTIONAL AREA=A1= 1799 SQ. FT.
STORAGE IN REACH=V1=123.9 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)=10195 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 10.9 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 1622 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)=111.7 AC. FT.

REACH OUTFLOW=QP2=10278 CFS
DEPTH OF FLOW=H2= 10.9 FT.

AD-A143 952 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
BRISTOL RESERVOIR NUM.. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JUL 80

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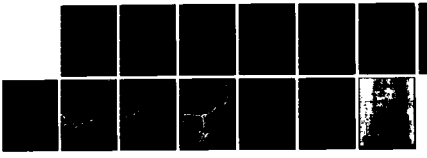
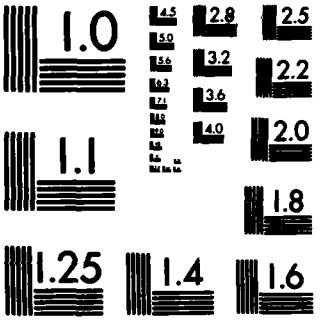


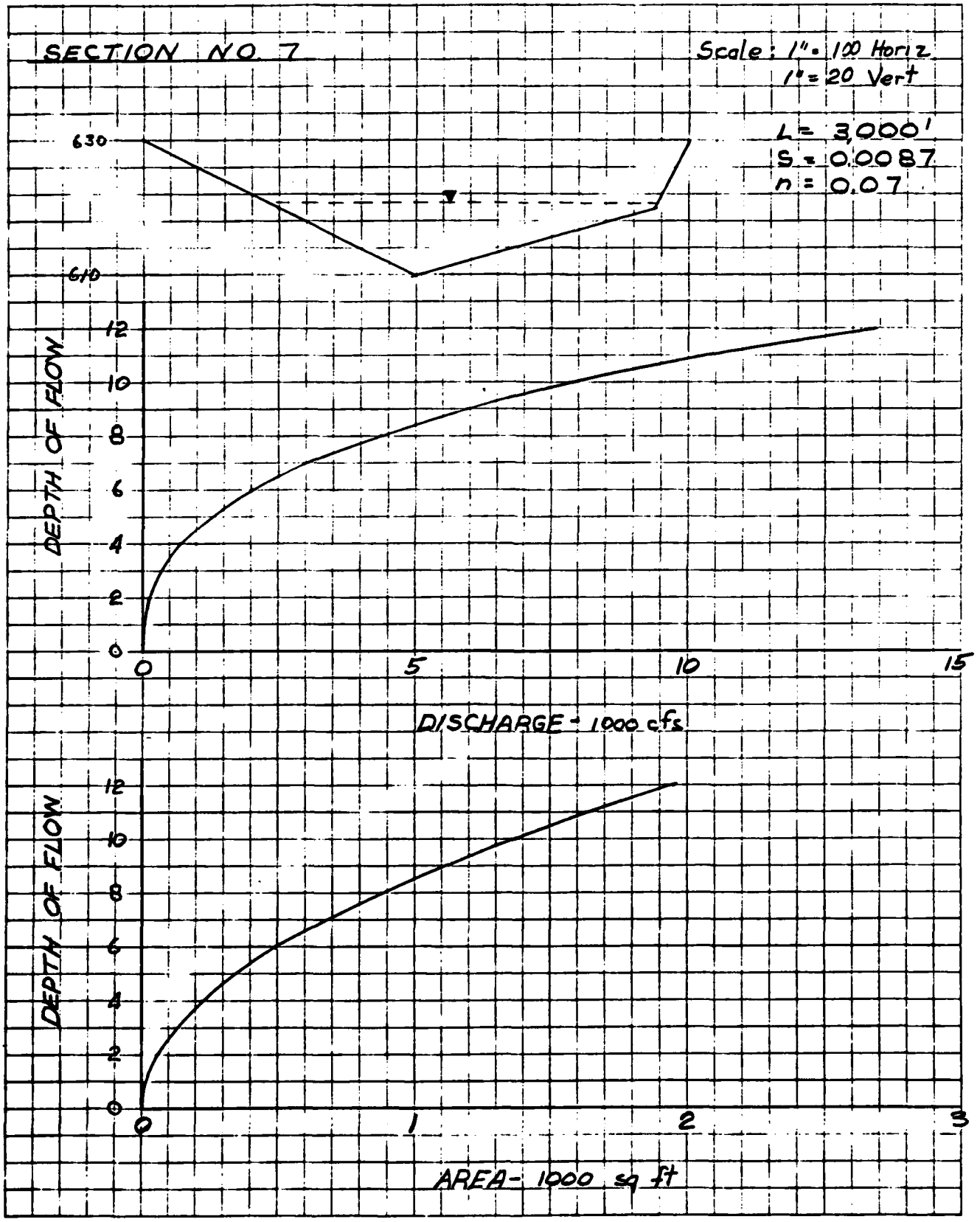


BY SAL DATE 4/30/80 **ROALD HAESTAD, INC.** SHEET NO 25 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO. 5 - Flood Routing



BY SAL DATE 7/3/80 ROALD HAESTAD, INC. SHEET NO 26 OF 37

CKD BY DLS DATE 7/3/80 CONSULTING ENGINEERS JOB NO 49-023

SUBJECT BRISTOL RESERVOIR NO. 5 - FLOOD ROUTING

SECTION NUMBER 8A

MAIN CHANNEL

H	W	A	R	S	V	Q
1.0	18	9	.50	.0059	1.43	13
2.0	35	35	.99	.0059	2.27	80
3.0	53	79	1.49	.0059	2.98	235
4.0	70	140	1.99	.0059	3.61	505
5.0	88	219	2.48	.0059	4.19	916
6.0	106	315	2.98	.0059	4.73	1489
7.0	123	429	3.48	.0059	5.24	2246
8.0	141	560	3.97	.0059	5.73	3207
9.0	159	709	4.47	.0059	6.19	4391
10.0	176	875	4.97	.0059	6.65	5815
11.0	180	1051	5.84	.0059	7.41	7787
12.0	184	1230	6.70	.0059	8.11	9980
13.0	187	1411	7.54	.0059	8.78	12385
14.0	191	1595	8.35	.0059	9.40	14991
15.0	195	1781	9.15	.0059	9.99	17792
16.0	198	1970	9.93	.0059	10.55	20782
17.0	202	2161	10.70	.0059	11.08	23956
18.0	206	2355	11.45	.0059	11.60	27309
19.0	209	2551	12.18	.0059	12.09	30839
20.0	213	2750	12.91	.0059	12.56	34541

MANNING COEFFICIENT=N=.0500

SECTION NUMBER 8B

RIGHT OVERBANK

H	W	A	R	S	V	Q
11.0	53	49	.91	.0059	2.14	104
12.0	57	102	1.79	.0059	3.36	343
13.0	61	158	2.60	.0059	4.31	682
14.0	65	217	3.36	.0059	5.12	1109
15.0	68	278	4.07	.0059	5.82	1616
16.0	72	341	4.74	.0059	6.44	2200
17.0	76	408	5.38	.0059	7.01	2858
18.0	79	476	5.99	.0059	7.53	3588
19.0	83	548	6.58	.0059	8.02	4391
20.0	87	621	7.15	.0059	8.47	5264

MANNING COEFFICIENT=N=.0500

SECTION NUMBER 8

TOTAL SECTION

	AREA			DISCHARGE		
H	A	B	TOTAL	A	B	TOTAL
1.0	9	0	9	13	0	13
2.0	35	0	35	80	0	80
3.0	79	0	79	235	0	235
4.0	140	0	140	505	0	505
5.0	219	0	219	916	0	916
6.0	315	0	315	1489	0	1489
7.0	429	0	429	2246	0	2246
8.0	560	0	560	3207	0	3207
9.0	709	0	709	4391	0	4391
10.0	875	0	875	5815	0	5815
11.0	1051	49	1100	7787	104	7891
12.0	1230	102	1332	9980	343	10323
13.0	1411	158	1569	12385	682	13067
14.0	1595	217	1812	14991	1109	16100
15.0	1781	278	2059	17792	1616	19408
16.0	1970	341	2311	20782	2200	22982
17.0	2161	408	2569	23956	2858	26814
18.0	2355	476	2831	27309	3588	30898
19.0	2551	548	3099	30839	4391	35229
20.0	2750	621	3371	34541	5264	39805

STORAGE AT TIME OF FAILURE=S= 866 AC. FT.
LENGHT OF REACH=L= 1300 FT.

INFLOW INTO REACH=QP1=10278 CFS
DEPTH OF FLOW=H1= 12.0 FT.
CROSS SECTIONAL AREA=A1= 1328 SQ. FT.
STORAGE IN REACH=V1= 39.6 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)= 9808 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 11.8 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 1285 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)= 38.3 AC. FT.

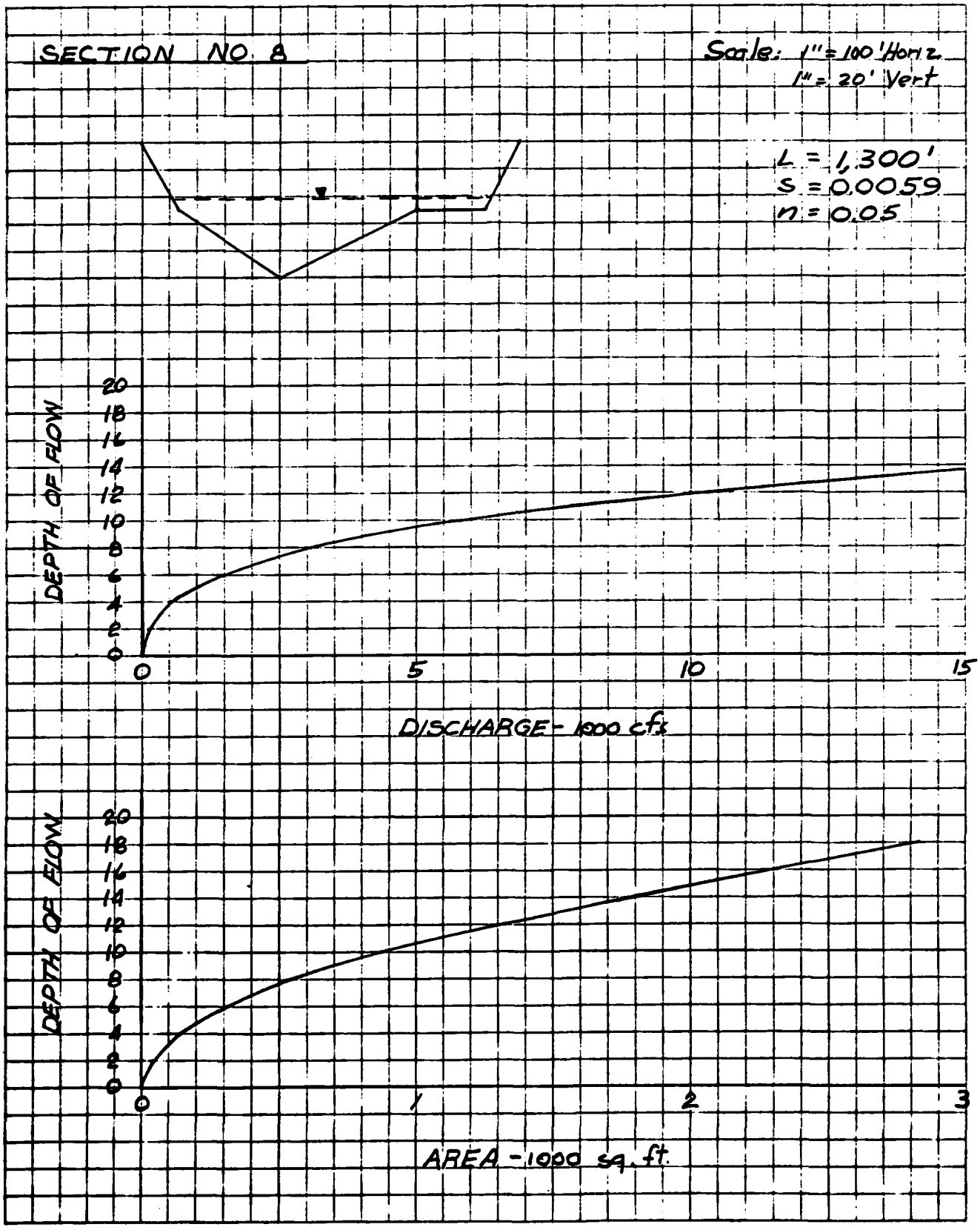
REACH OUTFLOW=QP2= 9815 CFS
DEPTH OF FLOW=H2= 11.8 FT.

BY SAL DATE 5/1/80 **ROALD HAESTAD, INC.** SHEET NO 29 OF 37

CONSULTING ENGINEERS

CKD BY DHS DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO.5 - Flood Routing



SECTION NUMBER 9

TOTAL SECTION

H	W	A	R	S	V	Q
1.0	613	552	.90	.0044	1.53	845
2.0	682	1199	1.76	.0044	2.39	2871
3.0	750	1915	2.55	.0044	3.07	5877
4.0	769	2674	3.48	.0044	3.77	10088
5.0	787	3452	4.39	.0044	4.40	15193
6.0	805	4247	5.27	.0044	4.98	21141
7.0	824	5062	6.14	.0044	5.51	27894
8.0	842	5894	7.00	.0044	6.01	35425
9.0	861	6745	7.84	.0044	6.48	43716
10.0	932	7663	8.22	.0044	6.69	51266
11.0	955	8606	9.01	.0044	7.11	61207
12.0	978	9571	9.78	.0044	7.52	71933
13.0	1001	10560	10.55	.0044	7.90	83440

MANNING COEFFICIENT=N=.0600
STORAGE AT TIME OF FAILURE=S= 866 AC. FT.
LENGHT OF REACH=L= 3000 FT.

INFLOW INTO REACH=QP1= 9815 CFS
DEPTH OF FLOW=H1= 3.9 FT.
CROSS SECTIONAL AREA=A1= 2629 SQ. FT.
STORAGE IN REACH=V1=181.1 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)= 7763 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 3.5 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 2274 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)=156.6 AC. FT.

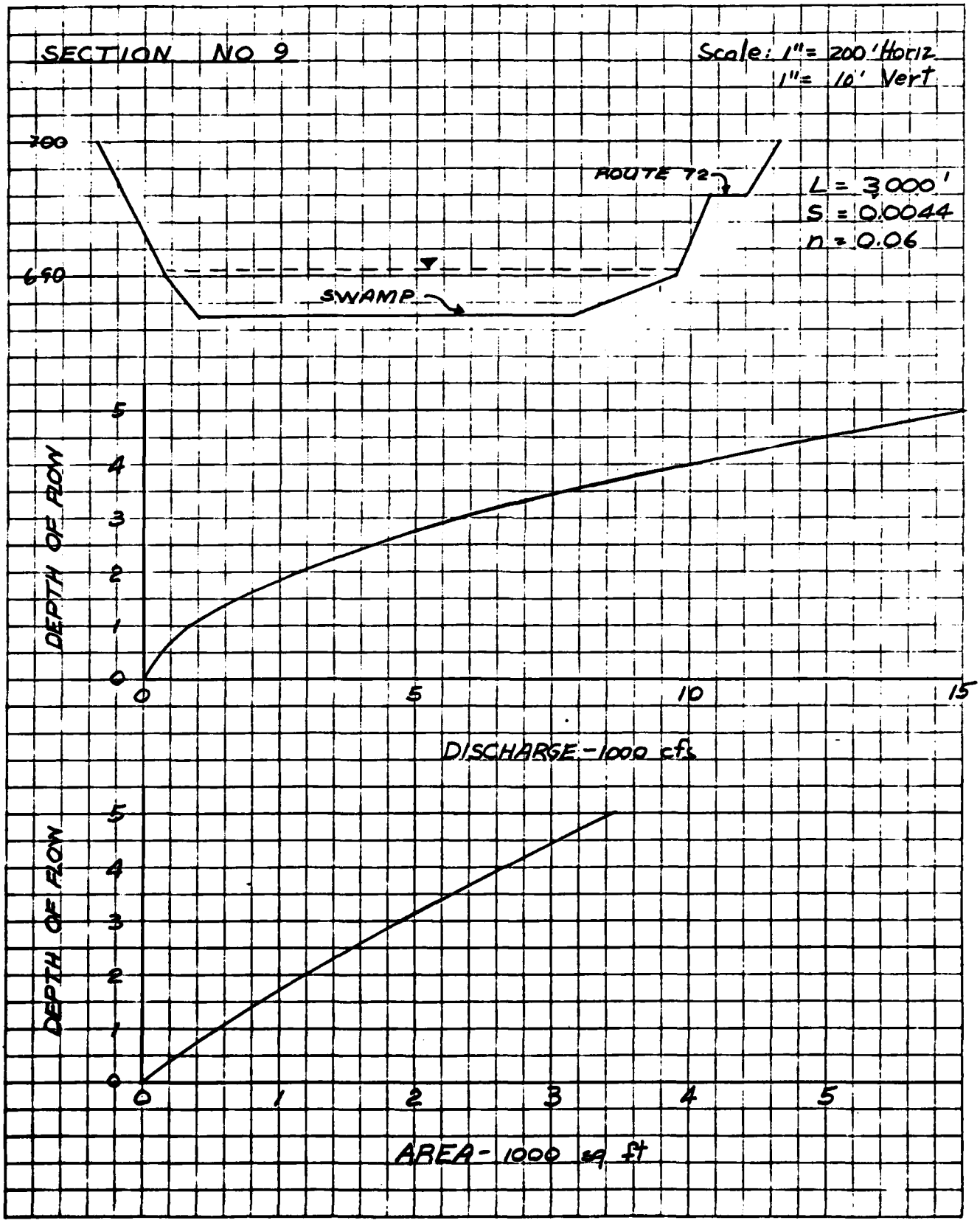
REACH OUTFLOW=QP2= 7902 CFS
DEPTH OF FLOW=H2= 3.5 FT.

BY SAL DATE 5/1/80 **ROALD HAESTAD, INC.** SHEET NO 31 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO 5 - Flood Routing



SECTION NUMBER 10

TOTAL SECTION

H	W	A	R	S	V	Q
1.0	162	148	.91	.0050	1.98	293
2.0	174	315	1.81	.0050	3.12	985
3.0	186	495	2.66	.0050	4.03	1994
4.0	246	732	2.98	.0050	4.35	3187
5.0	256	982	3.84	.0050	5.15	5060
6.0	266	1242	4.67	.0050	5.87	7292
7.0	276	1512	5.47	.0050	6.53	9870
8.0	287	1792	6.25	.0050	7.13	12785
9.0	297	2082	7.01	.0050	7.70	16034
10.0	307	2382	7.76	.0050	8.23	19617
11.0	317	2692	8.48	.0050	8.74	23532
12.0	328	3012	9.19	.0050	9.22	27780
13.0	338	3342	9.89	.0050	9.68	32363
14.0	348	3682	10.57	.0050	10.12	37283
15.0	359	4032	11.25	.0050	10.55	42543
16.0	369	4392	11.91	.0050	10.96	48146
17.0	379	4762	12.57	.0050	11.36	54094

MANNING COEFFICIENT=N=.0500
STORAGE AT TIME OF FAILURE=S= 866 AC. FT.
LENGHT OF REACH=L= 2000 FT.

INFLOW INTO REACH=QP1= 7902 CFS
DEPTH OF FLOW=H1= 6.2 FT.
CROSS SECTIONAL AREA=A1= 1309 SQ. FT.
STORAGE IN REACH=V1= 60.1 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)= 7354 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 6.0 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 1249 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)= 57.4 AC. FT.

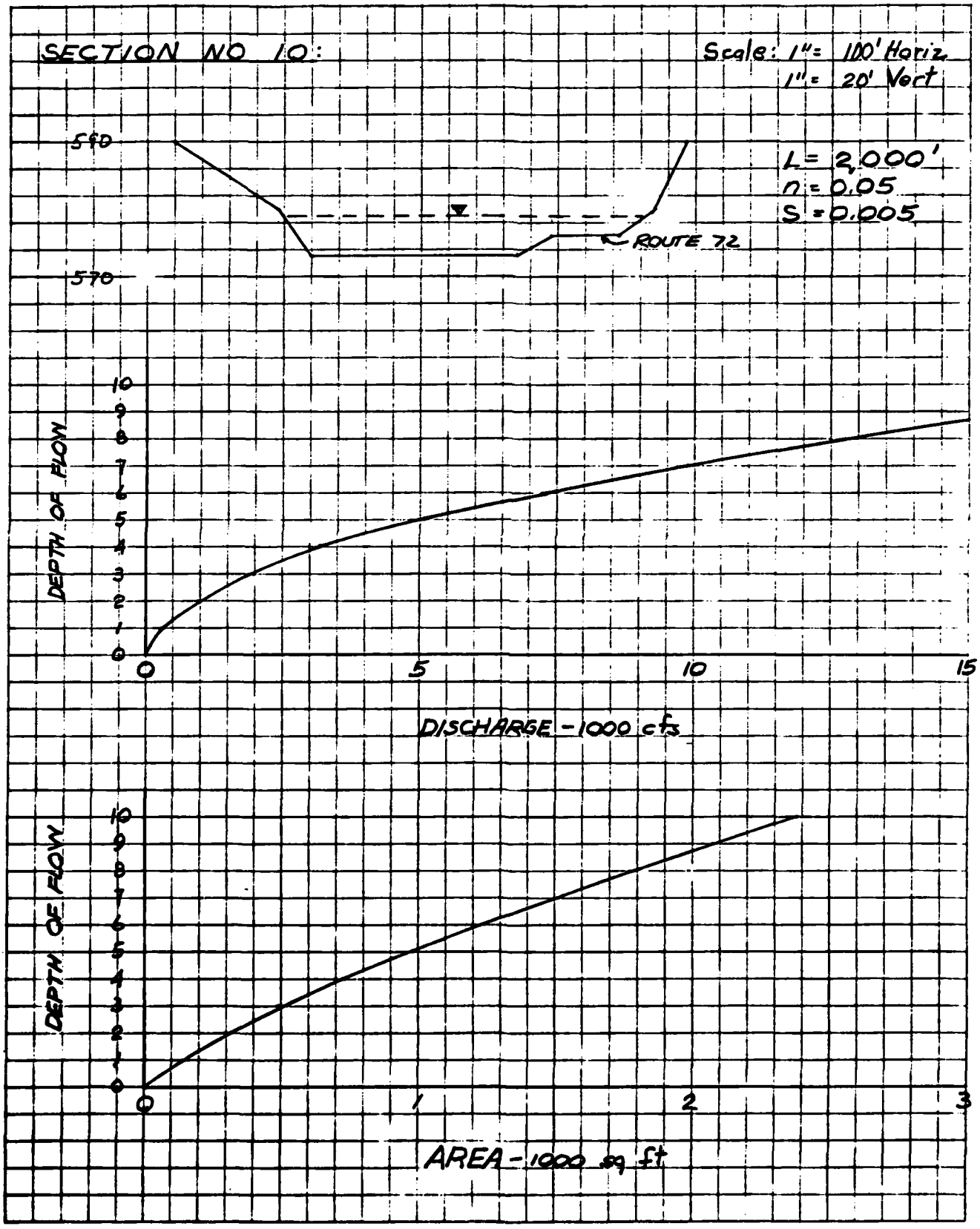
REACH OUTFLOW=QP2= 7366 CFS
DEPTH OF FLOW=H2= 6.0 FT.

BY SAL DATE 5/1/80 **ROALD HAESTAD, INC.** SHEET NO 33 OF 37

CONSULTING ENGINEERS

CKD BY DLS DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO 5 - Flood Routing



SECTION NUMBER 11

TOTAL SECTION

H	W	A	R	S	V	Q
1.0	20	10	.50	.0160	2.95	30
2.0	40	40	1.00	.0160	4.68	187
3.0	60	90	1.49	.0160	6.14	552
4.0	80	160	1.99	.0160	7.43	1190
5.0	100	250	2.49	.0160	8.63	2157
6.0	121	360	2.99	.0160	9.74	3507
7.0	141	490	3.48	.0160	10.80	5290
8.0	161	640	3.98	.0160	11.80	7553
9.0	181	810	4.48	.0160	12.77	10340
10.0	201	1000	4.98	.0160	13.69	13695

MANNING COEFFICIENT=N=.0400
STORAGE AT TIME OF FAILURE=S= 866 AC. FT.
LENGHT OF REACH=L= 1250 FT.

INFLOW INTO REACH=QP1= 7366 CFS
DEPTH OF FLOW=H1= 7.9 FT.
CROSS SECTIONAL AREA=A1= 628 SQ. FT.
STORAGE IN REACH=V1= 18.0 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)= 7213 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 7.9 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 618 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)= 17.7 AC. FT.

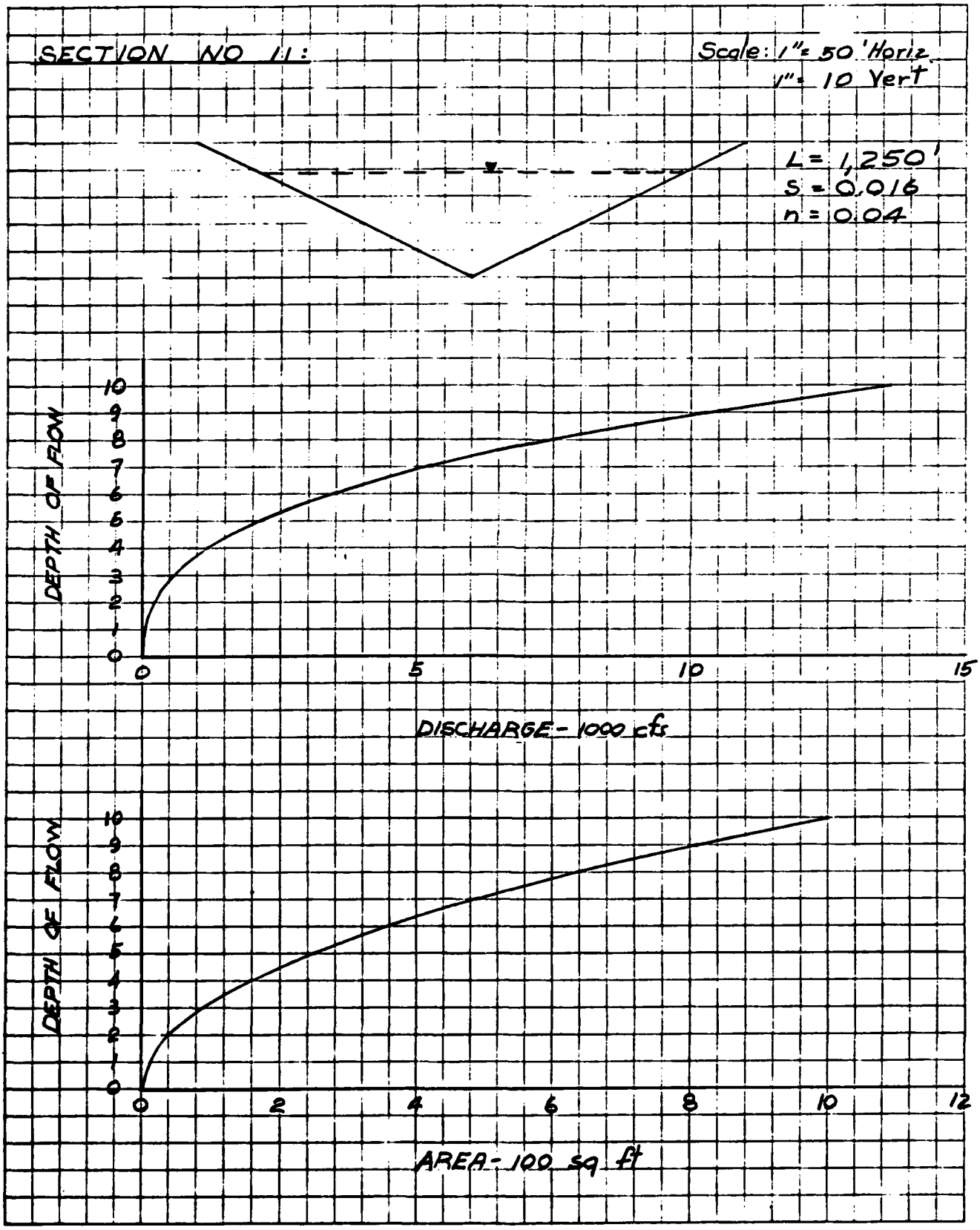
REACH OUTFLOW=QP2= 7214 CFS
DEPTH OF FLOW=H2= 7.9 FT.

BY SAL DATE 5/3/80 **ROALD HAESTAD, INC.** SHEET NO 35 OF 37

CONSULTING ENGINEERS

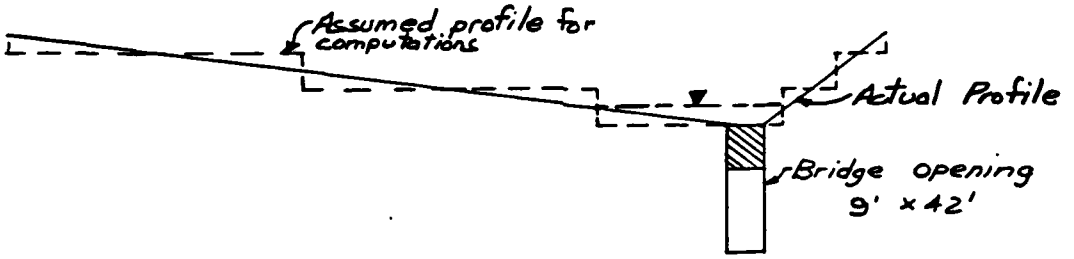
CKD BY DLS DATE 7/3/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-23

SUBJECT BRISTOL RESERVOIR NO 5 - Flood Routing



ROUTE 6

Scale: 1"=200' Horiz
1"=20' Vert



Data: 1) Wingwall Flare 30° to 75°
2) Total Head Available = (Hw) = 14.3' (before overtopping Rt. 6)
3) Assume bridge opening would discharge under inlet control conditions. (Use "Hydraulic Charts for the Selection of Highway Culverts")
3) Roadway discharge coefficient c=2.5.

Height Above Invert - ft	Bridge Opening discharge - cfs	Roadway Discharge (cfs)	Total Discharge Capacity (cfs)
14	5,670	0	5,670
16	6,300	1,414	7714
18	6,930	4,000	10,930

Q = 7,902 cfs (From section no. 9)

∴ Height Above Invert = 16.1 feet or 2.1 feet above roadway level.

Planimeter Readings:

1) Surface Area; Third = 2.47 sq in 0.37
First = 1.73 sq in 0.37
Start = 1.36 sq in

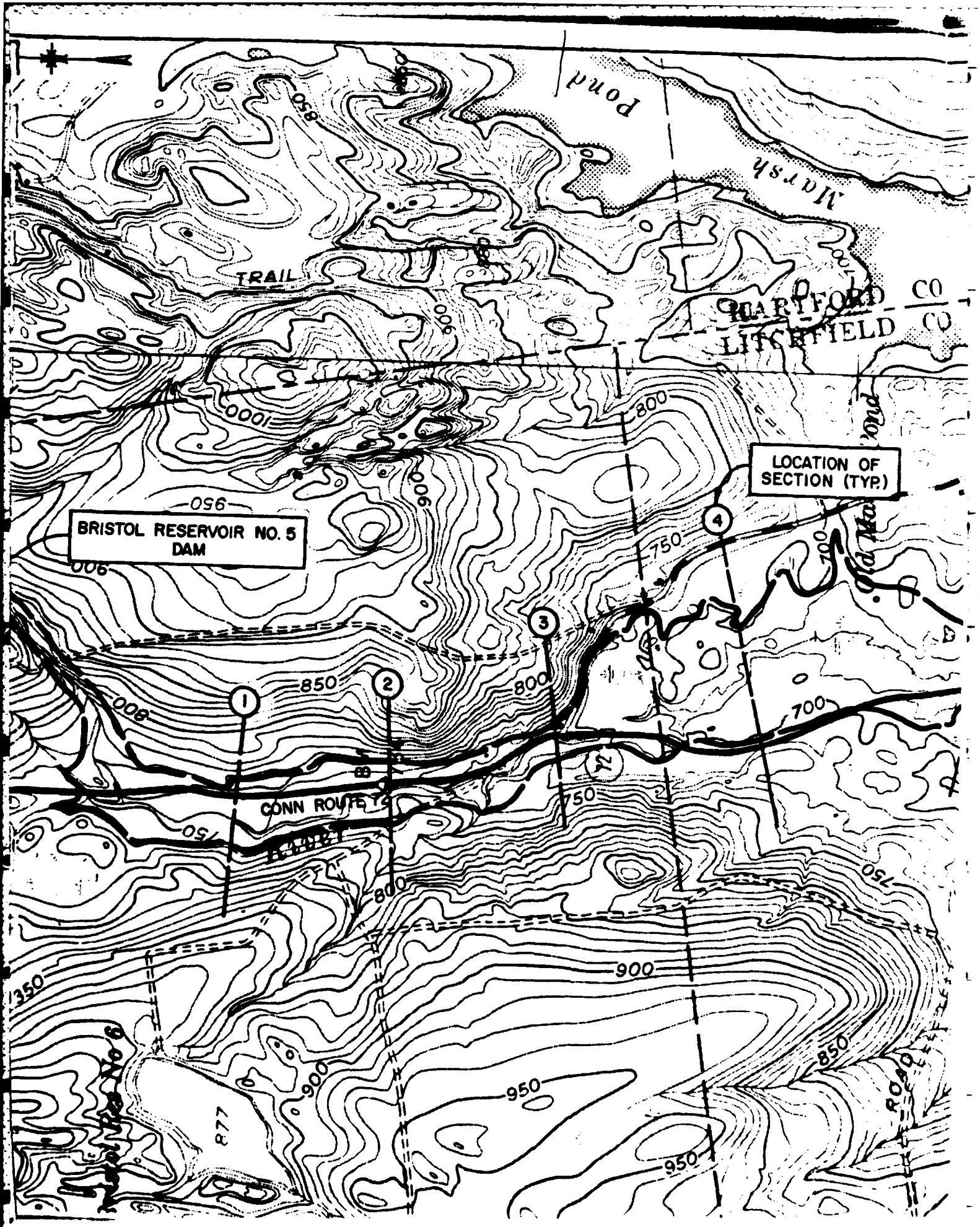
$$0.37\ in^2 \times \frac{(2000\ ft)^2}{in^2} \times \frac{1\ acre}{43{,}560\ ft^2} = 33.97 \text{ use } 34 \text{ acres}$$

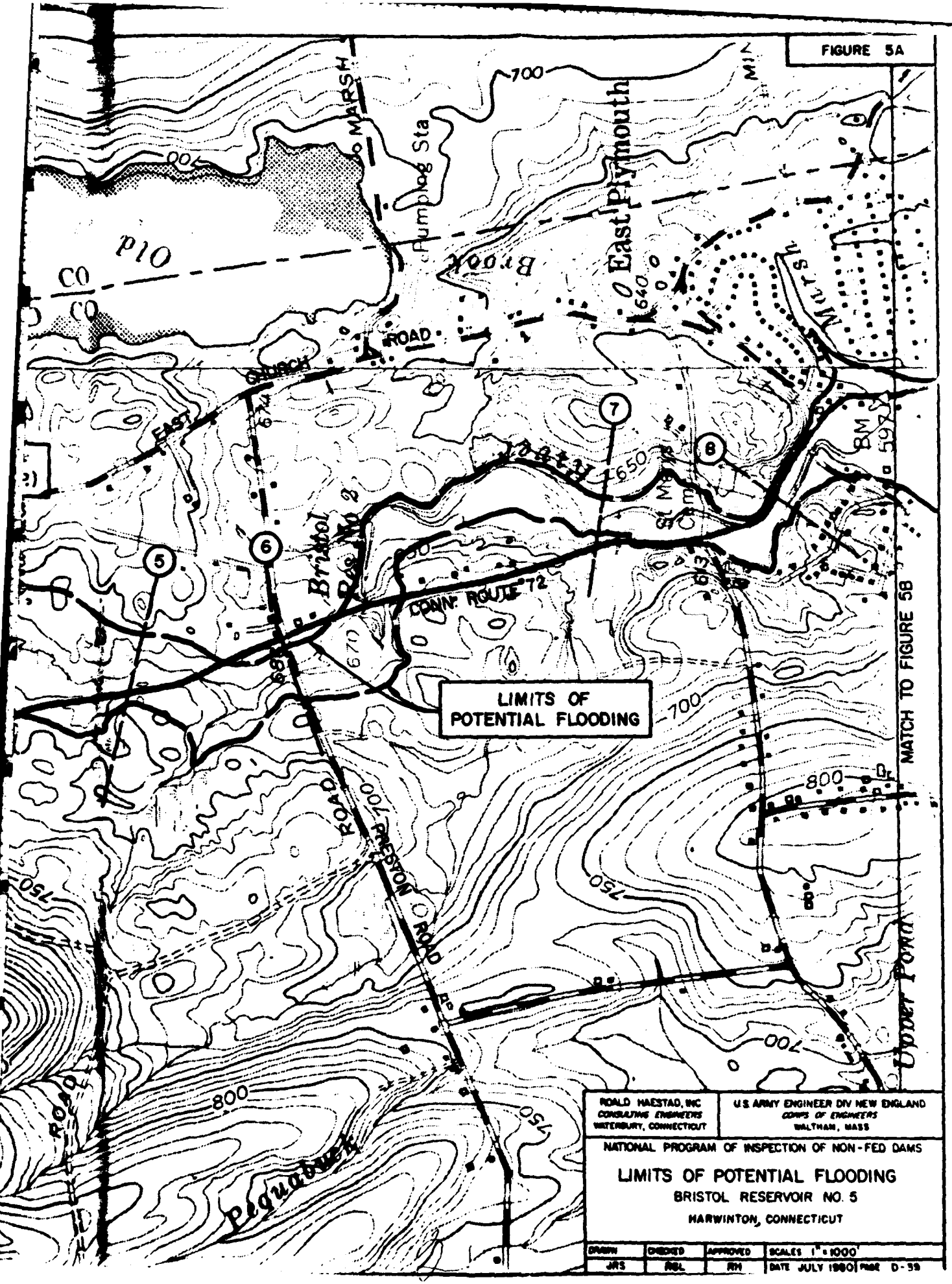
2) Watershed Area; Third = 24.40 sq in 7.69
First = 9.02 sq in 7.70
Start = 1.32 sq in

$$7.69\ in^2 \times \frac{(2000\ ft)^2}{in^2} \times \frac{1\ sq\ mile}{(5{,}280\ ft)^2} = 1.1\ sq\ mile$$

3) Contour 890: Third = 17.53 sq in 0.50
First = 16.52 sq in 0.49
Start = 16.03 sq in

$$0.50\ in^2 \times \frac{(2000\ ft)^2}{in^2} \times \frac{1\ acre}{43{,}560\ ft^2} = 45.9 \text{ use } 46 \text{ acres}$$


pond
Marsh
TRAIL
HARTFORD CO
LITCHFIELD CO
LOCATION OF SECTION (TYP.)
BRISTOL RESERVOIR NO. 5 DAM
Old Mine Rd.
CONN ROUTE 72
ROAD
850
900
950
800
750
700
1
2
3
4



ROALD HAESTAD, INC
CONSULTING ENGINEERS
WATERBURY, CONNECTICUT

U.S. ARMY ENGINEER DIV NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LIMITS OF POTENTIAL FLOODING

BRISTOL RESERVOIR NO. 5

HARWINTON, CONNECTICUT

DRAWN	CHECKED	APPROVED	SCALES 1" = 1000'
JRS	RBL	RH	DATE JULY 1980 PAGE D-39

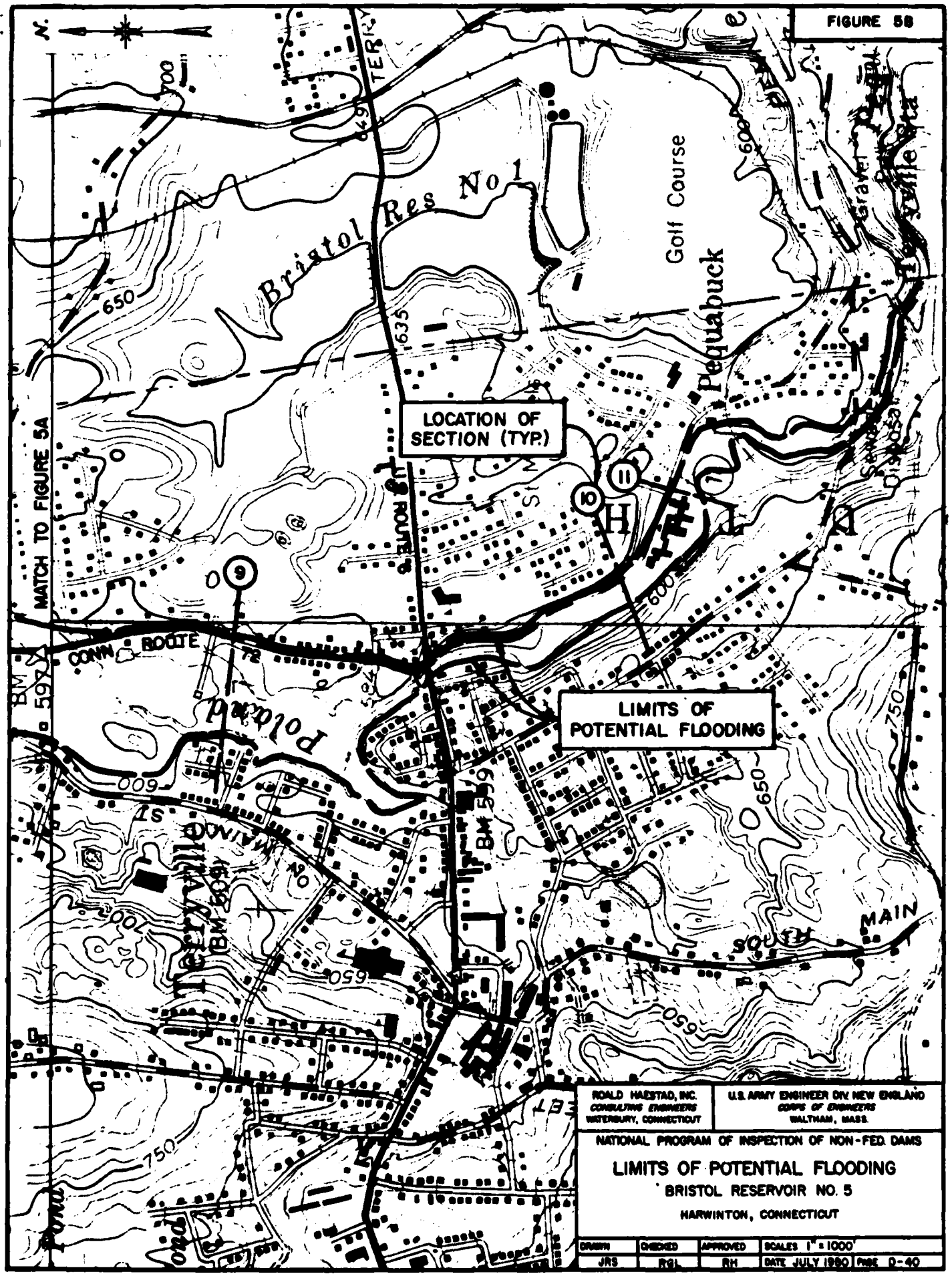


FIGURE 5B
N
Bristol Res No 1
Golf Course
Pequabuck
LOCATION OF SECTION (TYP.)
LIMITS OF POTENTIAL FLOODING
MATCH TO FIGURE 5A
ROUTE 6
CONN
BOOTE
MAIN
SOUTH
650
600
750
635
ROALD HAESTAD, INC.
CONSULTING ENGINEERS
WATERBURY, CONNECTICUT
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LIMITS OF POTENTIAL FLOODING
BRISTOL RESERVOIR NO. 5
HARWINTON, CONNECTICUT
DRAWN JRS
CHECKED RGL
APPROVED RH
SCALES 1" = 1000'
DATE JULY 1980
PAGE D-40

APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY | MO | YR
CT	366	NED	CT	005	06				BRISTOL RESEVOIR NO 5	4143.4	7300.5	15JUL80

POPULAR NAME	NAME OF IMPOUNDMENT
	BRISTOL RESEVOIR NO 5

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	08	TRIBUTARY TO POLAND RIVER	TERRYVILLE	5	6000

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE–FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE–FT.)	DIST	OWN	FED A	PRV/FED	SCS A	VER/DATE
RE	1932	S	60	60	844	620	NED	N	N	N	N	15JUL80

REMARKS
?ESTIMATE ?ORIGINALLY CONSTRUCTED 1921 RAISED 10FT IN 1932

O/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	640	U	30	1050	100000											

OWNER	ENGINEERING BY	CONSTRUCTION BY
BRISTOL WATER DEPARTMENT	METCALF AND EDDY	APA

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
CT DEP	CT DEP	CT DEP	CT DEP

INSPECTION BY	INSPECTION DATE DAY | MO | YR	AUTHORITY FOR INSPECTION
HOALD HAESTAD INC	08MAY80	PL 92-367

REMARKS
30 700FT DIKE ALONG RT SIDE OF RES 34 DIKE 3000 CY

END

FILMED

9-84

DTIC